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IV/3 1961

Dimensions, Backgrounds, and Uses of Habitat Groups

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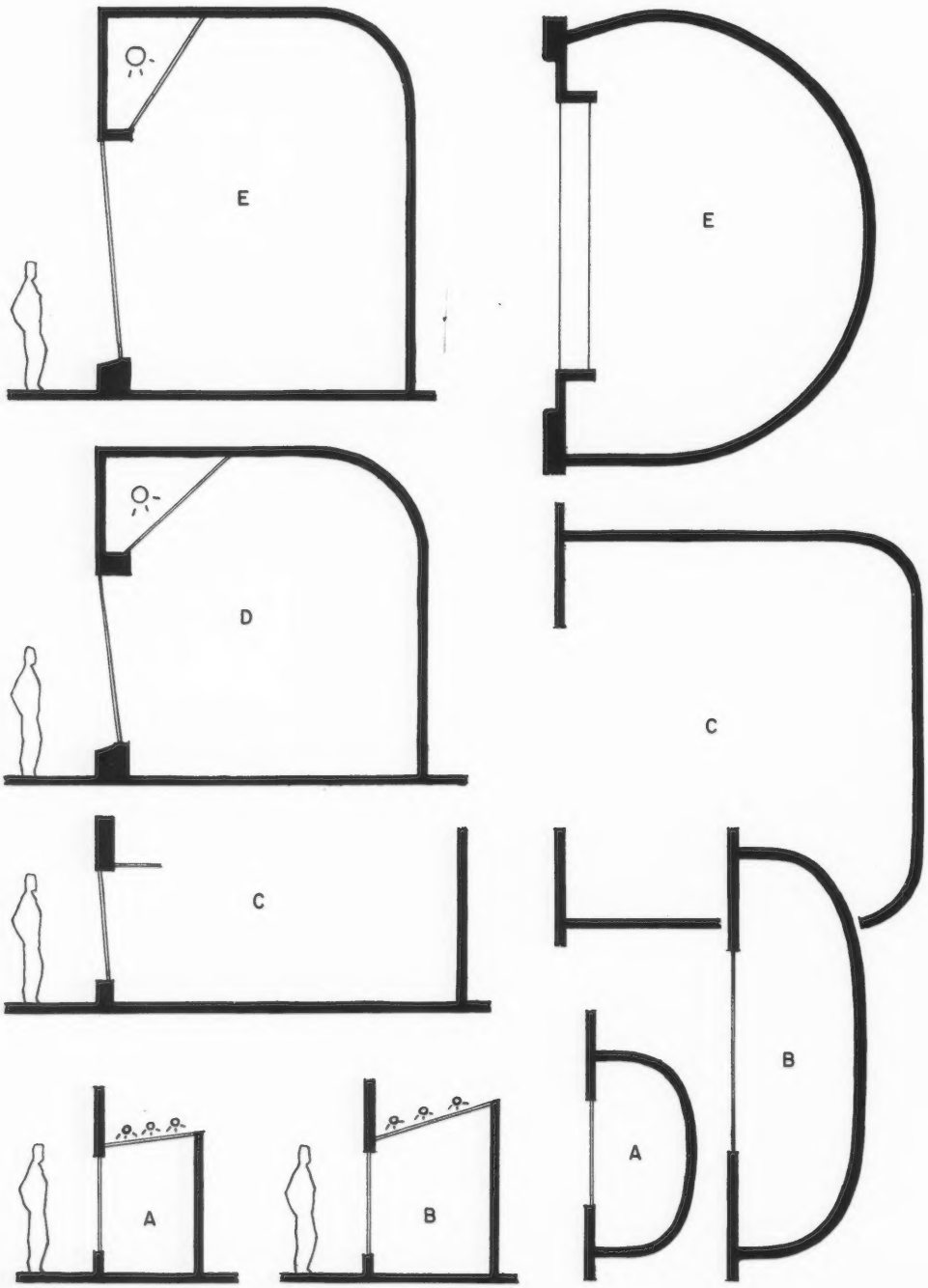
Comparison of habitat groups in different countries and different museums reveals no evidence of any unifying concept of ideal geometric forms and arrangements for exhibits of this kind. On the contrary, the variety of their proportions in the three dimensions and of their placement in architectural museum space is such that it does, at first, seem difficult to find any logical order in the diversity other than the logic of the simplest kinds of expediency coupled with the historical element of progressive improvement in the arts of preparation and display. But it soon becomes obvious that neither age nor institutional expediency will suffice to explain the range of differences that are there to be seen. As one continues to seek a rational explanation or interpretation it gradually becomes apparent that two divergent lines of evolution have been involved in the development of the habitat group and its adaptation to museum space.

In retrospect it now seems quite evident that the creators of the earliest habitat groups worked in the spirit of representational artists and not as practitioners of the arts of illusion. Whether or not they themselves were conciously aware of the distinction—and they probably were not—the fine exhibits they left behind give ample proof that complete visual deception was not their aim. Any doubts we may have on this point are dispelled when we sometimes find the full name of the artist boldly spelled out in letters one inch and a half tall, and of conspicuously contrasting color, painted as his signature on the background itself, with the year the work was accomplished. No artist of integrity, seeing illusion as his aim and responsibility, could allow himself, nor would he be allowed, to defeat his purpose for the gratification even of such a most natural desire for conspicuous identification with his work. The early habitat groups were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obviously looked upon as illustrations, rather than imitations or reproductions of nature. The artist's signature seemed quite as much in its place as it would be on an easel painting.

Under this concept of the habitat groups the question of their proportions and arrangement did not involve basic principles of display. An illustration can be painted to fit the size and shape of any canvas and the space of any page. A good example may be seen in the Hall of North American Birds of The American Museum of Natural History, which was perhaps the first complete hall devoted entirely to the habitat method of display. The proportions of the groups were not a consideration and do not show any general pattern. The depths were determined, with only slight variations, by the width of the space available between the false wall containing all the glass fronts and the structural wall behind the exhibits. The widths were governed by the needs of the contents to be shown, an eagle in its lonely eyrie needing only nine feet of elbow room, while a group of pelicans or a colony of lake shore birds require a spread of about eighteen feet each. The result is the range of dimensions indicated in Figure 1A, with the ratio between depth and width varying from 1:2 to 1:3.5.

But when we turn our attention from the horizontal to the vertical dimensions of these early habitat groups, we notice a feature of great uniformity representing the most primitive solution for one of the greatest dilemmas facing the designers of habitat groups: to have or not to have a sky. All the glass openings started very low near the floor and ended at, or slightly below adult eye level, forcing the entire direction of view downward and making it impossible or unnatural to look for a sky above, as shown in Figures 1A and 2. This made any painting of the ceiling quite unnecessary, and each habitat group was simply covered by a large glass plate through which illumination was admitted. It also disposed of the problems of perspective created by the need to bend the upper part of the background forward in the shape of a dome, when the visitors are permitted an upward view towards the sky.

For each single exhibit this method of avoiding the difficulties of the skies is perfectly acceptable. But, when the visitor is forced to cast his eyes down into one exhibit after another it tends to build up a depressing effect that may be quite strongly felt by some, although less disturbing

Fig. 1. Horizontal and vertical outlines of habitat groups. A and B. Early groups in the Hall of North American Birds of The American Museum of Natural History. C. Lion group in the Zoologisk Museum in Copenhagen. D. Characteristic profile of modern habitat groups in the United States. E. Alaska Brown Bear group in The American Museum of Natural History.

to others. Probably this emotional need to lift the eyes from the ground is the conscious or subconscious reason why exposure through windows ending below eye level has been universally abandoned as a general style, and is used only when the exhibits serve some special purpose, or when small exhibits are tiered below others at or above eye level in a desperate and discouraging effort to gain space or to show more than can be comfortably seen. But, although the modern habitat group does not force the eyes down, there is still a question of how far it permits an upward look into the skies.

Actually there were some museums that chose to disregard the dilemma of the sky even before, or without, the introduction of the curved half-dome above the diorama. The American mammal groups of the California Academy of Sciences were built on the same general principles as those illustrated in Figure 1A, but installed behind an opening rising eleven and a half feet above the floor, so that a visitor standing reasonably close has a very good view of the uncamouflaged glass lid of the display. The very fine impression created by these exhibits despite their brusque dismissal of a technicality may well cause one to wonder if the problem of the upward view may not have been somewhat overrated. But there can be no doubt that the urge to keep out of sight anything that could not be disguised as part of the natural panorama largely dictated the vertical dimensions of the early habitat groups in most museums.

As the habitat groups continued to evolve from their origins as three-dimensional illustrations, two different and in many ways opposed trends soon made their appearance. Several factors were involved, and it is impossible to tell which were given the first consideration. In museums that were partial to the open floor plan, with the exhibits surrounding a large and unencumbered central area, it was natural to seek a style of presentation that would have an effective impact across a considerable distance. Since one cannot increase the size or enhance the coloring of the animals and natural objects in the foreground, this distant effect depended heavily upon the quality of the background painting. Exposure to a distant view also made it desirable to increase the height of the open glass fronts as much as possible to lessen the feeling of confinement under low ceilings which the perspective of an entire wall would tend to accen-

Fig. 2. View of Hall of North American Birds in The American Museum of Natural History after modernization. Note that some exhibits are even lower than the one observed by the visitor.

Fig. 3. Bear exhibit in the Boston Museum of Science, typical of modern habitat groups in the United States.

Fig. 2

tuate. Increased height further reënforces the emphasis upon background painting. It also affects the permissible depth of the exhibit.

The taller the opening, the more narrowly confined to the front are the sources of illumination inside the exhibit, since they must be kept away from the upward angle of view. But, if a background is not to seem dim and unexciting even across a moderately wide hall, it must reflect a great deal of light, at the same time as it is not permissible to step up the illumination to the point where it becomes objectionable in the closer view. In the design of tall habitat groups for open halls it therefore becomes essential to hold the depth between glass front and background to

Fig. 3

a minimum. If at all practical the depth should be less than that allowed in exhibits with lower openings. It is interesting to note that the depth of the Alaska Brown Bear group in The American Museum of Natural History, with an opening that rises to twelve feet from the floor, is actually about three and a half feet less than the depth of the African Lion group in Copenhagen, with an opening that ends below six and a half feet from the floor, in spite of the fact that the bear group is about two feet wider than the lion exhibit.

As the background painting becomes more dominant and costly, it also acquires a higher order of meaningful contents. In the original three-dimensional illustrations the background was merely a limited extension of the foreground, giving additional details of the general type of environment inhabited by the species, such as northern woods, tropical rain forests, tundra, desert, lake shore, and so on. In habitat groups depicting scenes cloistered in deep vegetation, the ecological unity of background and foreground is, of necessity, still maintained. But in tall habitat groups drawing upon more open country for their subjects, more spectacular and more remote features are added to make the background effective at a distance. Often a marginal location, as in the edge or on a prominence in a forest, is selected for the illustration of a typically enclosed ecological niche, for the simple purpose of permitting a more distant and dramatic background view than the interior of the forest would allow. Bold geological formations and famous mountains or mountain ranges are shown. In a representation of low country the focus is not upon a near scene placed in a slight depression to confine and concentrate the view. On the contrary, the emphasis is upon the broad panorama of plains rolling to a distant horizon. For this, also, we may find a reason in the principles of perspective and psychology, although the practice probably grew from experience rather than theoretical considerations. Obviously the sight of a majestic mountaintop in the far background, or of the flat horizon of the plains, will retain its impact far better across another fifty feet of distance than would a boulder near at hand, filling the same area of the view.

With the use of these larger and bolder features of the broader environment, the background ceases to be a mere extension of the foreground. It is no longer part of the ecological niche of the species that are the primary subjects of the exhibit and may, indeed, have nothing at all to do with conditions of life in the foreground. Sometimes the background may even seem to function primarily as a digressive reminder that environmental circumstances entirely different from those of the foreground are not always very far away, as when the snows of Kilimanjaro are shown in the background of a display of life on the hot African plains. Through practical experience with the needs of tall exhibits that must be effective in open halls, the background has been emancipated from the

Fig. 4. Alaska Brown Bear group in The American Museum of Natural History.

details of the foreground to become a semi-independent geographic or geological tableau. This, in turn, has given rise to the concept of the multiple purpose habitat group.

The proponents of the idea that habitat groups should be deliberately selected and designed to serve the educational needs of several different disciplines can rightly point to the fact that their theory has already been put into successful practice in several museums featuring tall exhibits with emphasis upon the background painting. The habitat halls of these museums have already become vehicles for the study of geography, geology, and botany, as well as, and sometimes even with the neglect of, the mammals and birds that are usually the titular stars of the show.

The difference between backgrounds that merely extend the story told in the foreground and backgrounds primarily concerned with conveying a separate message of their own is sometimes quite obvious but can at other times be very subtle. It is true, of course, that the Grand Canyon of the Colorado is located within the wide domain of the American mountain lion. But the Canyon itself is unique and can in no sense whatever be described as a typical feature of lion country. Nor can it be said

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Fig. 5

Fig. 6

Fig. 7

Fig. 5. Mountain lion with Grand Canyon of the Colorado in background. The American Museum of Natural History.

Fig. 6. Coyote with El Capitan in background. The American Museum of Natural History.

Fig. 7. Osborn caribou in Telegraph Creek region of British Columbia. The American Museum of Natural History.

Fig. 8. Black bear in Big Cypress Swamp in Florida. The American Museum of Natural History.

Fig. 8

Fig. 9

Fig. 10

that the existence of the lion is naturally dependent upon the presence of the Canyon. The exhibit tells at least two almost unrelated stories, and tells them both very well. The same thing can be said about the relationship, or lack of relationship, between the wide range of the coyote and the spectacular mountain formations of Yosemite National Park. The coyote also roams the rolling prairies and is equally at home on the flat coastal plains of Texas.

On the other hand, even the distant ranges behind the Osborn caribou are of a kind with the foreground, serving to enlarge our understanding of the bleak and uniform environment of this species, just as the background of the black bear of Florida completes the picture of a cypress swamp for which space permits only a fragmentary representation by three-dimensional materials in the foreground. Other striking examples of background that supplement and extend the foreground even to the horizon are seen in the Gobi Desert, and the South American lagoon and pampas, habitat groups of bird life.

The relationship between the physical dimensions of the diorama and the evolving dichotomy of background and foreground is, of course, not always so simple as suggested in the preceding observations, nor is it without exceptions or deviations. Special circumstances may invite special solutions. In an exhibit of small mammals or birds habitually spending their lives in the cover of low-growing vegetation, the function of the background would actually be quite insignificant, unless it is given a separate task to perform. It is therefore entirely logical, for example, that a very fine but also fairly small habitat group of quail in the Dallas Museum of Natural History should be dominated by a background depicting the striking formations of the Chios Mountains.

A very different variant may be seen in the impressive African water hole diorama of the California Academy of Sciences, which combines many distinctive and interesting features, partly shown in Figure 11. The top of the opening of this display is nineteen feet above the floor. The exhibit nevertheless avoids the complications of multiple contents by a definite de-emphasis of the background, instead of the increased emphasis usually accompanying such a height of exposure. In the functional sense of visual impact upon the spectator, this de-emphasis reduces the background to a mere extension of the foreground, although the background painting actually does show mountains that might well have become an independent, though minor second theme of the display, if their forms had

Fig. 9. Birds of Gobi Desert. The American Museum of Natural History.

Fig. 10. Birds of South American pampas and lagoon. The American Museum of Natural History.

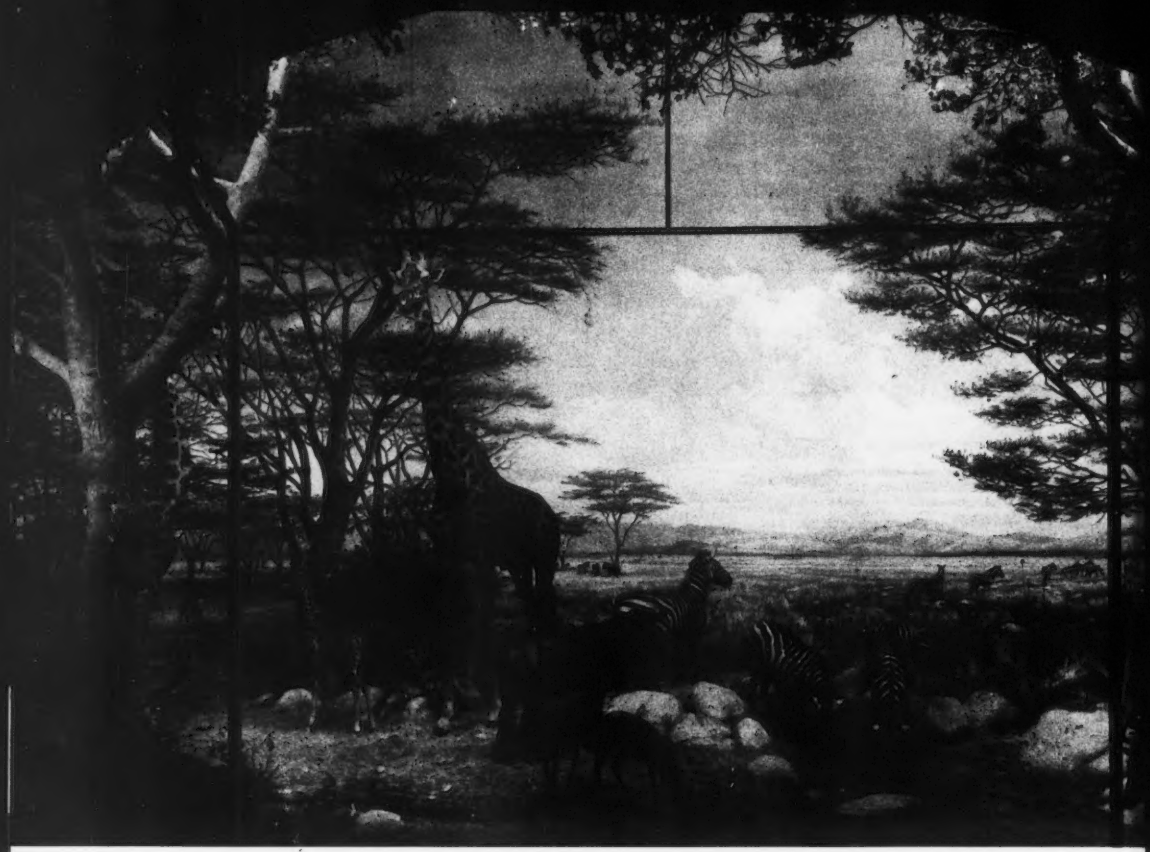

Fig. 11

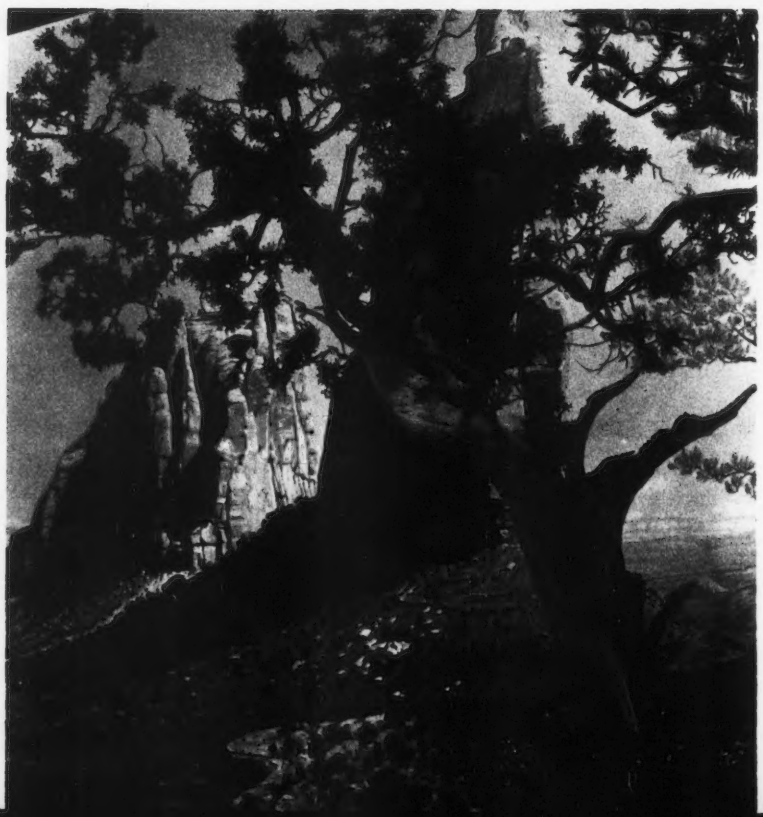

Fig. 12

been more conspicuously rendered. It is interesting to note that this underplaying of the background is associated with a depth of twenty-four feet, which is much greater than the interior distance from front to back at which the background can easily be given a prominent role under a dome that is closed above, with lights in front only. The lessons of this successful exhibit should be of value to all concerned with the problem of displaying large species requiring a lot of space in the foreground, and may help to provide a way out of the difficulties of some of the disproportionately high costs of large installations, about to be mentioned.

In spite of the great advantages of habitat groups of high exposure in open halls, this style of presentation is not without certain disadvantages that also leave something to be said for a different treatment of such displays. One disadvantage is, of course, the very great increase in cost. This involves both the indirect costs of space requirements, especially when the scheme of open halls is used, and the direct costs of creating the exhibit itself. Owing to its size, and the esthetic demands placed upon it, the background painting becomes the most expensive item of the exhibit and may even cost more than the entire rest of the display. To make the background effective, particularly at some distance, a high general level of illumination is used in all daytime habitat groups, which, in turn, precludes economic shortcuts in the preparation of foreground material.

Another disadvantage is the lack of focus and concentration upon a subject which becomes unavoidable when many different exhibits are simultaneously in view, and when each exhibit is in internal competition between several disciplines for the star role of the show. In the Colorado Piñon and Juniper group in the Hall of North American Forests, at The American Museum of Natural History, it might be difficult for a visitor not predetermined upon what he wants to study to decide whether to give his attention to the trees that are the theme of the entire hall or to the magnificent geological formation of the ship rock in the background. One might also note that, while habitat groups serving multiple purposes may be very helpful to classes and individuals who can repeat their visits for the separate pursuit of each of the subjects that are dealt with, such exhibits tend to be confusing to visitors who must try to take it all in during a single visit and are likely to end the day by having seen much but learned little on their trip.

Fig. 11. African water hole. The California Academy of Sciences, San Francisco. Over-all width of opening fifty-three feet, central glass pane twenty-nine feet wide.

Fig. 12. Foreground juniper and background ship rock. The American Museum of Natural History.

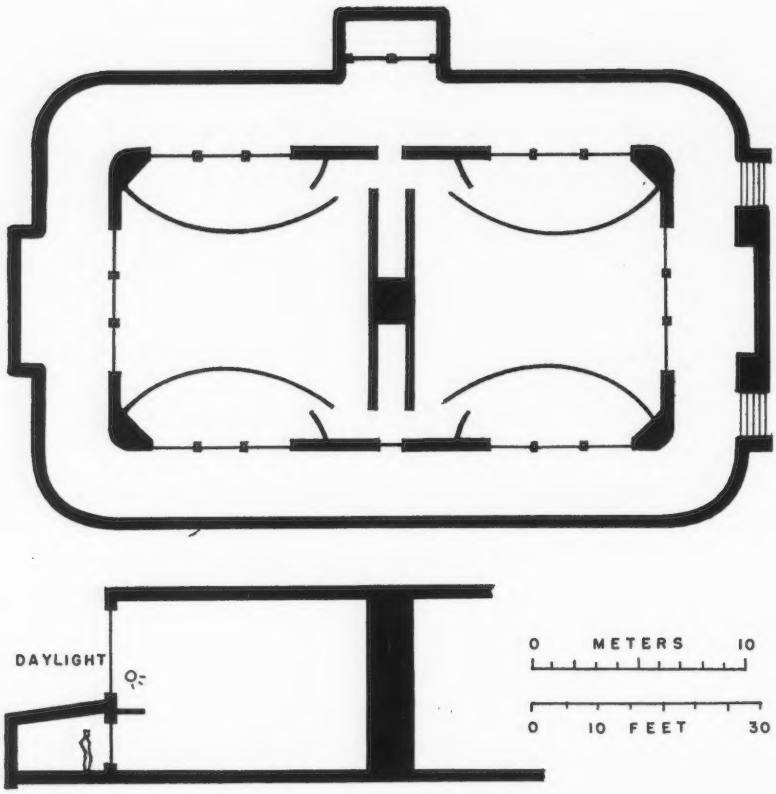

Fig. 13

The fact that many different habitat groups will actually be held in view simultaneously in the open hall arrangement, and therefore must put a strain upon the visitor's powers of attention, is shown by the need to fix the horizons of all exhibits in an open arrangement at exactly the same level, in order to avoid even more disturbing conflicts of competing impressions.

Apart from such very special exhibits as that of Biologiska Muséet in Stockholm[1] the multiple-purpose, high-exposure habitat groups have had the greatest development in the United States, and I believe one may be permitted to add that they have been particularly far advanced in The American Museum of Natural History.

In many European institutions, and perhaps most notably in various Scandinavian museums, the history of the habitat group has followed a different course. Instead of being arranged around an open central space in a large hall, the exhibits were generally placed in the relative intimacy

[1] See CURATOR, vol. II, no. 2, p. 119, figs. 16A, 16B.

Fig. 14

Fig. 15

Fig. 13. Diagrammatic ground plan of Biologiska Museet in Uppsala, with profile of one of the two largest habitat groups, prepared from sketches supplied by Intendent Bengt Ekström.

Fig. 14. Normal visitor's view of one of the two largest exhibits in Biologiska Museet in Uppsala.

Fig. 15. The second of the two largest exhibits in Biologiska Museet in Uppsala, photographed to reveal interior shape, dimensions, and structure.

Fig. 16

Fig. 17

of corridor-like areas, or in lateral alcoves of quite limited width. Even when a large hall would seem to have been architecturally available, one may find it reduced to an ambulatory around a central "island" of habitat groups placed back to back. A particularly interesting example may be seen in Biologiska Museet in Uppsala, as shown by the floor plan given in Figure 13. It will be noticed that both of the entrances to the hall face blank walls, so that the exhibits can be seen only after the visitor has entered the confines of the ambulatory, and also that only one habitat group at a time can be held clearly in view. This arrangement avoids the diffusion of intent and attention that may be caused by having many exhibits present themselves simultaneously within the field of vision of the visitor. It permits no clear impression and sometimes scarcely even an awareness of the next exhibit until one stands before it. Needless to say, this greatly facilitates concentration upon the contents of each diorama.

The arrangement used in Uppsala results in some challenging shapes and dimensions, particularly in the large exhibits at the two ends. These have a depth from front to back of about thirty-nine feet, and a maximum width of about thirty-three. The interior ceiling height is about twenty-six feet, but the glass opening ends only seven feet above the floor, with a wide vizor inside. That these rather extreme forms can be effectively used is shown in Figure 14. In Figure 15 one should notice the proportions of bear and bull moose both to the depth and to the height of the

Fig. 16. Visitor observing spotted seal exhibit in Zoologisk Museum in Copenhagen. Compare with Figures 2 to 4.

Fig. 17. Lion group in Zoologisk Museum in Copenhagen. Compare with Figure 1C, and note the effective use of depth by the arrangement of the animals and of their large prey.

interior and should relate the shape revealed on the right to the floor plan shown in Figure 13.

The lack of a wide area for the movement of visitors in front of the groups also precludes the distant view and thereby eliminates the need for tall openings with all their attendant problems of cost, illumination, and background motif. Exhibits designed to be seen only at close range can well stand a considerably greater distance between the opening and the back of the case, with significant gains for the presentation of three-dimensional foreground material.

Habitat groups consistently designed for intimate arrangement are therefore characterized by apertures that extend high enough to avoid forcing the eyes downward, but not much higher; by relatively great depth, which may sometimes equal or exceed the width;[2] by a generally lower key of illumination that permits some economies in the artistry of presentation, without being in any way inadequate for the near view; by emphasis upon taxidermy and foreground treatment; and by a retention of the background painting more or less within the framework of the particular ecological niche that is the theme of the whole assembly.

Probably the finest example of this treatment of the habitat group carried to its logical conclusion may be seen in the lion exhibit fairly recently installed in the Zoological Museum of the University of Copenhagen. Here the opening ends well above eye level, but well below six and a half feet from the floor. At the top of the glass, an opaque vizor more than two feet wide extends horizontally into the case, cutting off the upward view without forcing the eyes down. The problems of the sky are eliminated as completely as they were by the low apertures of the earliest habitat groups, but without the undesirable side effects. No artistic treatment of the ceiling is required, and illumination can be extended far into the case without exposure of its sources and yet without any undesirable increase in the general level of light intensity. Figure 17 bears testimony to the excellent quality of the image created by a fine exhibit prepared and presented in this manner, and shows that there are more ways than one of meeting the problems of the habitat group, according to architectural and economic circumstances, and educational purpose.

In conclusion it must be admitted that the rationalizations used in this and other articles to explain the history of museum methods and philosophy are, of course, in the nature of interpretations by hindsight, which might possibly, at times, seem as surprising to the movers of museum history as our theories of evolution would be to the evolving species. But this, in itself, is not an argument against the validity of the theories.

[2] Even without taking into account such a special arrangement as that used in Gothenburg (see Parr in CURATOR, vol. II, no. 2, p. 114, figs. 12A–C).

An Undergraduate Research Program at a Museum[1]

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The American Museum of Natural History, because of its varied offerings in exhibition, education, research, and scholarship, has had wide experience with students. Many have come to study the exhibits; others, to partake of the special lecture courses; and still others (usually on their own initiative), to seek opportunities to participate in the broad research program of the Museum. Within the past ten years, more than 300 students —from high schools, colleges, and graduate schools—have been engaged for different periods of time in our research activities. Several high school students have carried out research so well that they have qualified for top honors in science talent contests; several undergraduates have published their researches in scholarly journals; and a number of graduate students (of which the author is one) have completed doctoral dissertations at the Museum. In fact, graduate studies have been going on for many years. In addition to temporary college teaching assignments frequently undertaken by our scientists, the Museum has a formal arrangement with Columbia University and New York University by which several members of the staff are also included as part of the permanent professorial staff of these universities. In such capacity they give regular curriculum courses at the Museum, utilizing the vast collections of study material, and they supervise directly the students' dissertations.

[1] Based on an address given at the meetings of the American Association for the Advancement of Science, December 28, 1960.

Student associations on all academic levels have been mutually pleasant, productive, and profitable. As a result the staff was greatly interested when the Special Projects in Science Education Division of the National Science Foundation announced an Undergraduate Research Program for the financial support of college students participating in research programs.

The purposes of this program, as stated by the National Science Foundation, are:

> 1. To accelerate and enrich the development of undergraduate science students through participation in current reseach. Although the student may not be ready to carry on original investigation on his own, he can share genuine research experience with competent research scientists.
> 2. To provide new and expanded means for able students to advance in their understanding of scientific methods.
> 3. To meet, in some measure, the need of the undergraduate student, to experience at first hand the meaning of research in his field of study.

The National Science Foundation approved the proposed schedule of research of the Museum and, in the summer of 1959, an Undergraduate Research Program was initiated.

The advantages in having an organized program are several:

1. It permits the staff to plan for the participation of students in research projects. In the past, research opportunities for students were scattered and haphazard. Sometimes departments were able to fit students into projects; at other times they were not. However, the organized program provides a specific niche for the student, and the investigator can plan on his participation.

Of particular note are the field projects which receive many requests from students each year. Formerly, most field projects had no funds to provide for students' maintenance and traveling expenses, and most of these requests had to be denied. Now the National Science Foundation program provides financial aid for students to join field expeditions.

2. Students who sought us in previous years were, to some degree, preselected. Only those students who could afford to work without pay were available to us. Now the stipend offered in the program permits selection on the basis of scholarship and other qualifications without regard to financial need.

3. It permits selection of candidates from a broader group of students who represent many geographical areas and universities.

SELECTION OF STUDENTS

Printed brochures listing research projects are sent to most colleges and universities in the East and to a scattering of schools in the Middle West

and West. Students apply, requesting participation in a specific project. Applications (including a transcript, two letters of recommendation, and a short essay) are carefully evaluated, and interviews are arranged, wherever possible. The interviews are conducted by the program director, the investigator in charge of the research project, and occasionally one other scientist. All students are notified as to whether or not they have been selected and, although this procedure involves much paper work, it is necessary when students are chosen in an open competition. We are often saddened when we make our final decisions, for usually four or five students, equally as competent and bright as each one selected, must be refused.

During the summer of 1959, we had one hundred and twenty-three applications for eleven student positions; in the summer of 1960, one hundred and sixty-six applications for seventeen positions. These applications came from students in approximately seventy colleges in twenty states.

During the academic year, our students of necessity come from colleges and universities within commuting distance of the Museum. In 1959–1960 we received seventy-two applications for nine positions. However, in the recent program, 1960–1961 we received only sixteen applications, again for nine positions. Such a small number of applicants may reflect a decision by the National Science Foundation to reduce the stipend which virtually put these students on a volunteer basis and eliminated the financially needy ones.

The academic background of the students ranged from freshman to senior, with equivalent numbers applying from each class. It is difficult to say to which class the best students belong. Seniors, naturally, are better grounded in the sciences and therefore are able to comprehend more advanced work. However, in some field projects, lower classmen who are amateur naturalists are better choices than seniors who have spent all their time in the laboratory. The nature of the project is the determining factor in the final selection, and it is not possible to say which class of students is best suited—the choice is made on an individual basis. Here, as elsewhere, brightness seems to require the addition of curiosity and hard work and an inner need on the part of the student to do something constructive.

Students are assigned to the various research projects and work directly under the supervision of the investigator. Those in the summer work full time; those in the academic year, part time, approximately eight to ten hours per week.

As part of their participation, students present their research findings at seminars arranged specifically for them. During the academic year 1959–1960 four such seminars were held. In the first two, students pre-

sented reviews of the current status of research in their general areas of investigation. At the close of the academic year, in the last two seminars, they presented talks about their own research accomplishments. At the close of the summers of 1959 and 1960, a similar student research seminar was held.

In addition to the seminars, each student is required to submit a written report on his work. We believe that the written report and the seminars accomplish the purpose of providing opportunities to the students to learn of other areas of research, to gain experience in public speaking, to meet future colleagues, to organize their own material, to evaluate and interpret data, and to write scientific reports.

RESEARCH PROJECTS

The spectrum of research at The American Museum of Natural History is broad, and it offers a variety of projects to the undergraduates. Taken on an individual basis, each research project may be compared to research performed at universities. However, when taken as a composite, the research here is unique in that it exposes students to highly concentrated work in anthropology, biology, and geology. Few colleges have the extensive collections needed for studies in speciation and evolution or field stations which provide optimal facilities for extended projects.

Students in the program found places, either at the field stations or at the Museum, in animal behavior, anthropology, astronomy, botany, invertebrate zoology, herpetology, mammalogy, ornithology, and paleontology.

For example, during the summers 1959 and 1960, nine students worked at the Kalbfleisch Field Research Station of the Museum in Huntington, Long Island, on various projects, such as the spectrum analysis of the radio frequency radiation from Jupiter, population dynamics of small mammals, population ecology, the breeding behavior of birds, and the analysis of the vegetation and flora of certain fields. Five students worked at the Southwestern Research Station, Portal, Arizona, on the behavior and biology of army ants, the embryonic adaptation of frogs and toads, and the vegetation of the Chiricahua Mountains. Other students, in Mexico, at marine stations, or at the Museum, studied the significance of voice in the reproductive behavior of frogs and toads, schooling in fishes, fish sounds, the evolution of birds of prey, passerine birds in aviaries, the significance of early experience in mammals, the forebrain function in fishes, and the evolution of deep sea corals.

During the academic part of the year 1959–1960 students engaged in such varied projects as the development of behavior in fishes and in mammals, the evolution of birds in the New Guinea-New Britain area, passerine birds in aviaries, the forebrain function in fishes, and morphological variation in human crania and skeletons.

Fig. 1. Aspects of student and student-instructor field and laboratory work.

EVALUATION OF STUDENT EXPERIENCES

All the students selected for the program had excellent scholastic records and good recommendations. However, as briefly mentioned above, student performances were variable and seemed to depend more on previous interest and general intellectual abilities, such as reasoning and creativity, than on academic standing. For example, two students, both seniors, both city-bred, both Phi Beta Kappa candidates, applied for projects on fish behavior. One was selected to work on forebrain function in fishes, the other on schooling in fishes. The first student quickly grasped the nature of the problem, in which he conditioned fish to respond to a target, removed their forebrain, and retested them. He discovered that there was a significant increase in the latency of response and more variability in response. As he continued in the program, he proved capable of supervising two other students. He prepared his paper for publication and is presenting his research at the meetings of the American Society of Zoology. He showed a brilliant aptitude with direction and ability to concentrate on the problem without charging off into many "leads." On the other hand, the student working on schooling (who was equally bright, on paper) could not grasp the principles of experimental research and had to be placed on a routine task which required little creative ability. The differences between the two showed the extremes in level of ability of "equal" students. Most of the other students were considered highly satisfactory, tackling, in many instances, difficult theoretical and technical problems. For example, two students, working on the effects of stress in the early environment of mammals, found that the timing devices interfered with their observations. In response to this difficulty, they designed and made a highly refined and complex timer which signaled the experimenter and programmed observations without in any way disturbing the animals (Fig. 2). In addition to their participation in the main project, each engaged in an experiment of his own conception and design, attacking the problem with minimum guidance. One student worked on the intensification of stimulation and its effect on the defecatory reaction. He found that the defecatory reaction was increased. He would have discovered this fact earlier if he had read the literature, although he approached the experimental design in an original fashion and verified the earlier results without prejudice.

Unawareness of what has gone before is one of our major problems with undergraduates. They seem to resist library work. Therefore, if the program teaches them only the value of library research, it will have made a major contribution to their scientific development.

The other student's problem concerned differential response to shades of gray by rat pups at the time of eye opening. His preliminary results showed that they preferred the darker shades when presented with a

choice of light and dark. He soon discovered, however, that a small technical flaw in the equipment was operating as a cue to the pups. Thus he could not clearly tell to what the pups were really responding. Once again such an experience is one that a science major can never gain in an ordinary laboratory course—knowing about controls and experimental design cannot be taught as effectively as it can be learned by actual research experience.

Two students working in anthropology attempted to determine whether or not a relationship exists between the individual areas of the skull and the size and shape of the skull. They ran into technical problems of measuring the bones and cranial capacity of the skull. They discovered that the cranial capacity measurements were highly variable at first, but as they repeatedly performed the technique (of pouring millet seed into the skull) they became more accurate. Though they did not complete the experiments and obtain conclusive results, they were not discouraged with research, and each has continued his studies with graduate work in anthropology.

Two students worked on the bird collections at the Museum. At first, working with prepared bird skins did not seem so exciting as live material, but these students soon discovered that the story of evolution could be unfolded as they opened the storage drawers containing thousands of birds. In one case, the student worked on the exquisite birds of paradise, studying species, subspecies, and hybrids. Some of the work involved a knowledge of distribution, and she prepared many maps. The other student analyzed relationships among North, South, and Central American species of *Accipiter,* hawks with sexual dimorphism in which the female is larger, an adaptation that is not yet fully understood. Both students discovered that, although the species is the fundamental biological unit, there are many problems in the analysis of just which groups constitute a single species, in the relationships of species to one another, and in the effects of distribution in time and in space.

A number of students were engaged in field work. Here, in addition to their scientific research, they learned a bit more about adjustments to living in close proximity with their colleagues and investigators.

At the Kalbfleisch Field Research Station, five students were in residence during the summer of 1960: three worked on interrelated problems in biology; two worked on radio astronomy. The problems in biology concerned long-term studies on the ecology of bird and mammal populations and the floral make-up of the Station. Students trapped and banded birds and marked mammals over twenty-four-hour periods. They observed and recorded the numbers of species at the Station. One student ran into technical problems with the mammal traps, finding that they were not completely adequate for the job. They were frequently demolished by

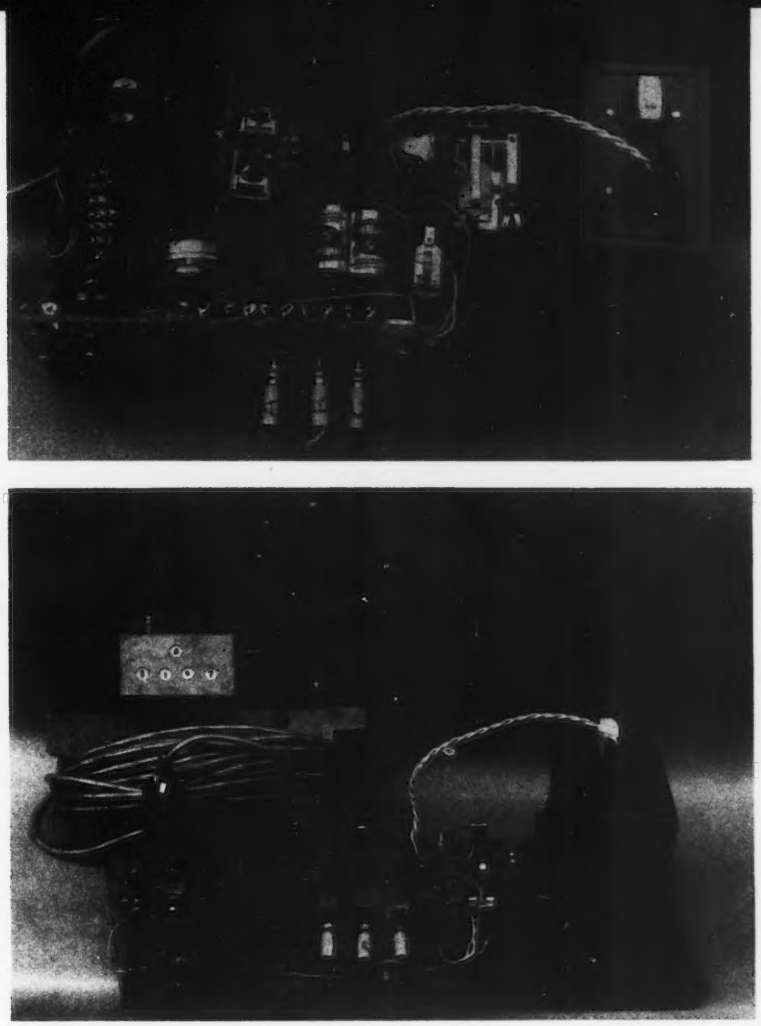


Fig. 2. Timer and mobile sequence-display unit designed and constructed by two students.

larger mammals, they heated up to 100° F. on warm days, and they needed frequent washing which changed their characteristic aroma. Once these problems were solved, the remaining task of collecting, marking, and tracking was eased. (The student felt that a period of two months was insufficient for a good survey and that the work should continue throughout the year.) Many valuable experiences were derived from this study and others. First, the students found that field work is hard; some had to work eighteen hours a day. Second, seemingly adequate equipment, laboratory-designed, does not always suit field conditions, and, third, living with other students in related work provides both irritations and at the same time stimulating discussions. They all helped one another and discussed their

common and uncommon problems. In fact, they became highly knowledgeable about their own research area and other areas. The biology majors garnered much on radio astronomy from their station mates, as did the astronomy majors on biology.

Other field expeditions took students to Mexico, Marine Studios in Florida, the Woods Hole Oceanographic Institute in Massachusetts, and the Southwestern Research Station in Arizona. In Mexico, two students carried out individual research projects on the influence of vocalization of movements in the toad (*Bufo*) and on movements and orientation in the tree frog (*Hyla*). Each student devised and carried out his own problem after preliminary field experience. The results were not conclusive, but each realized that there is room for continued efforts. At the Southwestern Research Station, the student working with army ants had to adjust his time according to the activities of the ants—frequently staying up all night in order to observe the ants and then working during the day on other phases of this project. Another student worked on determining developmental rates of several species of frogs at different temperatures and also followed his own problem in which he made a comparison of the morphology and distribution of two species of the lizard *Sceloporus*. This student would not have been able to carry out his project had he not been experienced in herpetology. He worked seven days a week, he collected frogs and snakes, and he required little guidance.

The students were enthusiastic about their experiences. I quote, "A research project of this type affords one many opportunities which would otherwise be unavailable to the student. The finest minds in the world of anthropology were our mentors and the world's most superb collection of skeletal materials was our laboratory. It would be virtually impossible to work in this atmosphere and not to gain a wealth of invaluable knowledge. To be grateful hardly seems adequate."

The majority of investigators were pleased with the students but wished that the students were able to work more independently. One investigator summed up his feeling about his students and their contributions, and I think he presents, in general, the views of other investigators:

> Both obtained . . . worthwhile data, and each is supposedly preparing a separate report. However, to judge by their outlines and our discussions, considerable work on my part will be entailed before their respective papers are ready for publication, along with suitable illustrations. . . . Now when each is returning to school I hope that they get their papers prepared before they become swamped with new courses. . . .
>
> Frankly, I'd forgotten how little undergraduates know, and in particular, I am distressed to find how much difficulty both of these students (despite their scholastic records and a certain amount of ingenuity in setting up experiments) have in organizing their data and expressing

> themselves coherently. I am convinced now that it is a mistake to make selections largely on the basis of scholastic records, although to NSF officials this may seem more defensible than other methods. But regardless of his scholastic record, a student with a previous interest in the problem, preferably enough interest to have covered some of the literature, would be eminently preferable to those with no previous experience or interest in a rather specialized field of investigation.

BENEFITS OF THE PROGRAM

1. To the Museum:

a. A major result of such a program at the Museum is the encouragement and training of new people in the sciences of natural history.

b. It permits the Museum to continue and to expand its activity in education—training students to meet the increasing need for scientists in this country.

c. It permits the Museum staff to plan projects in which students are an integral part—removing the randomness from student assistance.

2. To the student:

a. To most of the students the opportunity to observe and participate in continuing research projects is an entirely new experience. There is no doubt that the college student gains much, in both tangible and intangible experiences. The program serves to expose the student to a vast number of stimuli. They all grow a little in wisdom and maturity.

b. A great number of students apply from colleges in which their own research opportunities are limited to molecular biology, biochemistry, or bacteriology. The Museum's program offers them research in natural history and at field stations (to many this opportunity is extremely important), and they discover that research in natural history is possible, is modern, and is rewarding. It encourages those interested in natural history by demonstrating to them that modern experimental and observational techniques are applicable.

c. The students are in contact and work closely with scientists other than their own professors.

d. During the summer, in particular, the stipend is important, for it frees the student from financial burdens and allows him to devote his energies fully to his project.

In closing, here is a quotation from another of our participants:

> They (the investigators) have been generous with their time and patient with my shortcomings. Their criticisms have been constructive and their compliments rewarding. This work has been unique for a person of my academic status [he is a freshman]. The true worth of the summer's job goes beyond the scientific projects already mentioned. I count it as one of my most educational and influential experiences.

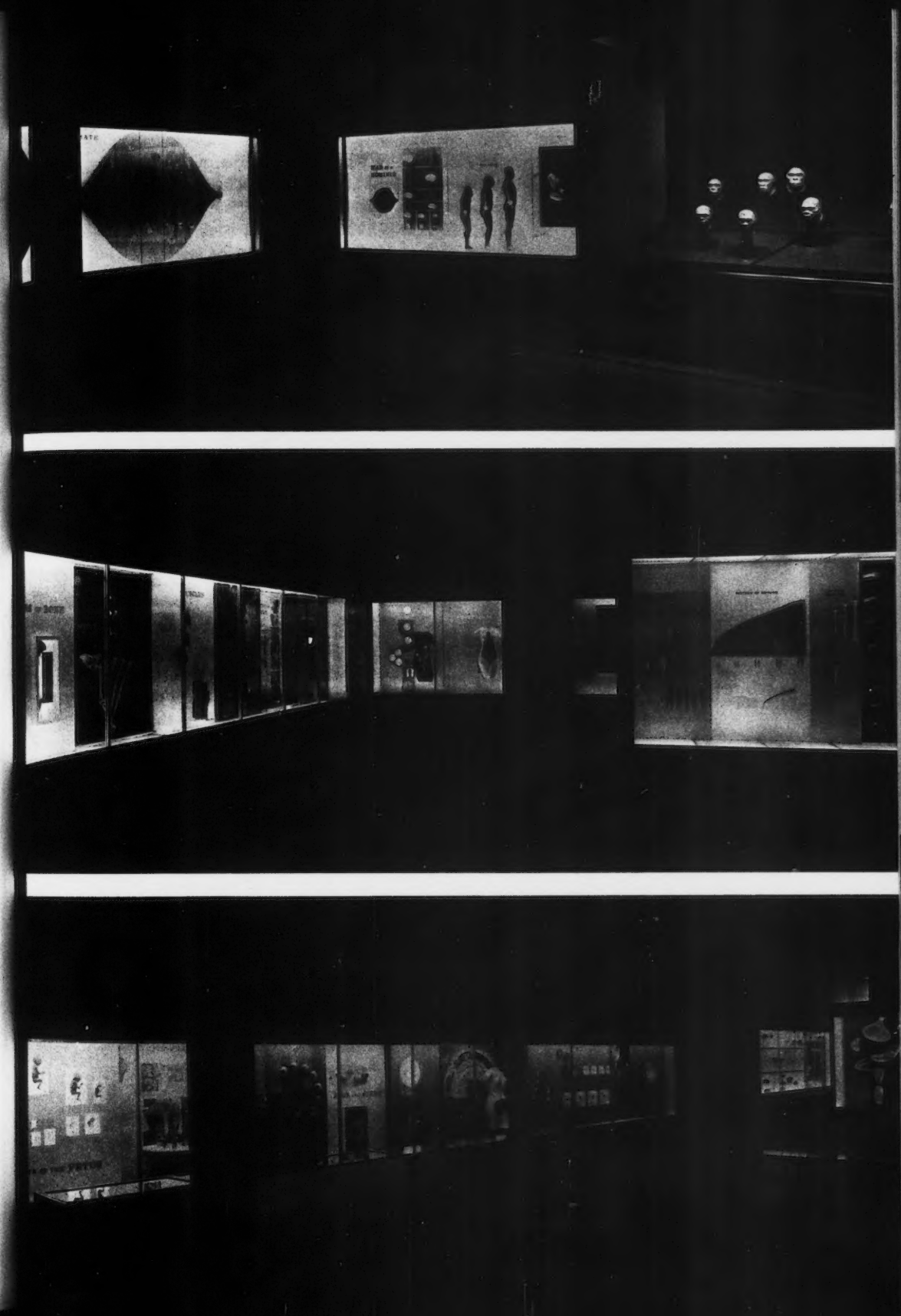
Some Observations on the Function of a Scientific Exhibit

HARRY L. SHAPIRO, CHAIRMAN
DEPARTMENT OF ANTHROPOLOGY
THE AMERICAN MUSEUM OF NATURAL HISTORY

The following observations on the function of a scientific exhibit and the nature of the public for which it is designed were delivered at the opening of the Hall of the Biology of Man in The American Museum of Natural History on March 20, 1961. I hope the reader will bear in mind that the theme of my comments might under different circumstances have been enlarged, although I think I have given the essence of what I had to say. And I hope that no reader will assume for a minute that, in touching on the ideas I have, I am suggesting they are the only ones to engage the careful consideration of an exhibit planner. As a final explanation, I have kept the text as it was spoken to an audience and have made no alterations to convert it into a "written" piece for publication.

Before the hall is turned over to you for your inspection, it may be of some interest and, perhaps, of a little value to give you an idea of the kind of thought that went into its planning and the sort of policy that directed its development. Now I suppose that no two exhibits are ever quite alike in the problems they present, the decisions they call for, or the specific purposes they serve. Yet despite this uniqueness of each exhibit, there are some general considerations that apply to many of them alike and warrant our reaching some broad conclusions about exhibits, particularly scientific ones, and their function in the life of a community such as ours. Art shows and exhibits constitute, I suspect, another category with somewhat different conditions and purposes.

At the very outset, there is the question of choice in a subject such as human biology where the possibilities, at best, at this early stage, seem



infinite and almost unmanageable in what always turns out to be very restricted space. But choice in this kind of situation is not a settling merely on what will be most dramatic or easiest to display, but what is most significant for the purpose in view. An exhibit is like a book; it can never cover every detail and every facet of its theme; it must be selective. The difficulty, moreover, is especially acute in a field such as human biology. This is an area of extremely active research with shifting frontiers where knowledge is rapidly accumulating.

The extraordinary abundance of biological research, together with the tentative nature of its most advanced victories, creates, moreover, certain hidden pitfalls. There is the risk of rapid obsolescence before such an exhibit is well started on its career, if one is too bold in advancing up to the very edge of the research fringe. On the other hand, the safe and conservative course dictated by over-timidity may deprive an otherwise effective exhibit of the excitement and challenge of new concepts and new knowledge. These are, of course, matters that call for a nice balance of judgment, but they are also matters that are involved in one's concept of what a good exhibit should do. And this naturally brings us right up against the social context in which any exhibit must exist, namely, its public.

The needs of the public that this Museum serves are, I think, constantly uppermost in our minds here. They are, of course, diverse, but one set of them arises, I believe, out of a peculiarly characteristic dichotomy of our times and to which I have been sensitive in my conception of this hall. This is the dichotomy between the generation educated in the more relaxed days many of us here can remember and the younger people who have just completed or who are in the midst of their schooling. It is a dichotomy that extends into the different areas of knowledge in which each division feels at home, and particularly it involves acquaintance with the new learning of science. If anyone doubts the reality of this split, I suggest they talk with parents of children growing up today. It is astonishing how many are delighted with, bewildered by, or aghast at, as the case may be, the fund of scientific knowledge their young "geniuses' possess and their easy familiarity with space, electronics, dinosaurs, minerals, genetics, or the plain facts of life.

How did this come about? There are as least two good reasons that go a long way in explaining it. One is the consequence of the increasing tempo of scientific advance and progress. There is a whole speech in this which I am sometimes prepared to deliver, but I need only point out here that never before in the history of man have new discoveries been piling up at the rate they have now achieved. And the end is not in sight. In fact, it has been estimated that the greater part of the content of textbooks in use today was not even known a generation or two ago. Those

of us who took physics thirty years ago are lost among the neutrons and the positive and negative ions that our children learn in their elementary courses. As for chemistry and biology, the situation is the same. If there ever was a time when a scientific education might have been expected to last out one's life span in good repair, that time is certainly not now. How much more vast is this chronological split where the older generation was schooled, as so many of us were, in a classical tradition without science.

The other reason, but complementary to the first, is the revolution that has taken place in our world and that has recently been extending into the educational process. This is the increasing dominance of science in politics, industry, and every-day life. Although science has been changing our world for quite some time, the dramatic break-through into full public consciousness dates back only to the post-war period and the atom bomb. Suddenly almost everyone has become aware that in the rough, tough world we live in, science plays a major role—a terrifying role to be sure—but one we cannot ignore in safety. At least we are all convinced that this is the case. As a result, science, not so long ago rather neglected in school curricula and attractive generally to rather odd and off-beat characters, now is assuming an increasing significance not only in public policy but in the share it receives of school time. But not only is more science being taught, it also begins at a far earlier level than used to be the rule. As a result, our children are receiving a scientific orientation, and vastly greater numbers in our colleges and universities are turning to careers in science. All this, of course, mirrors our growing preoccupation with science, but it also reflects the need for an informed public and for a technically trained corps in our society, faced as it is with the competitive pressures of our world. Its effect at any rate can be measured by the widening chasm of the generations.

This is where the role of the museum and of an exhibit of this sort comes in. For many of us, whose formal schooling is over, it is often difficult or impossible to resume it in any satisfactory or systematic manner. Yet, as I have been stressing, the need, even the right, to know what is happening in science is pressing and necessary. We hope to fill this need and to recognize this right by displays like the one we are opening this afternoon, and to do so for your pleasure and delight as well. By the same token, our younger members of society require the stimulation of the wider horizons that a museum exhibit can clearly provide.

For all these reasons I have set the highest standards I could. I have not over-simplified. I have given it as straight as I could devise. Some of nature's processes are complicated and demand some effort to understand. These are dissected out as best we could, but never by distortion or by gimmicks.

I trust that even a brief visit to the Hall of the Biology of Man will give

you something, and that even with a minimum of biological background you will understand and profit from the displays. But if only one visit will suffice to encourage you to think you have learnt all there is to know here, I shall count it as a failure. For although I have aimed to be lucid, have sought to arrange the displays to appeal at various levels of training, I have tried to give the various exhibits sufficient detail and density so that our visitors as they leave them will feel that they want to come back for another look. An exhibit that does not do that, in my book, is thin, superficial, and is not doing the job it can and must do.

A Free-standing Exhibit Case Unit

GLENN R. DOWNING, CHIEF CURATOR
IDAHO STATE COLLEGE MUSEUM

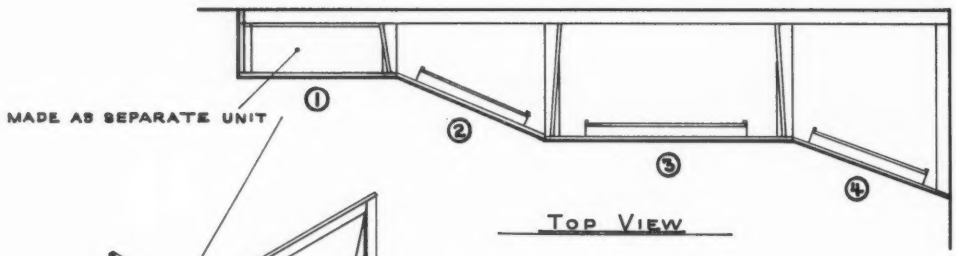
A new exhibit case unit, designed to be free standing for a room corner, has recently been installed in the Idaho State College Museum. It was designed for temporary panel displays, and, not being attached to the wall or floor, it can be easily removed for changing to other types of exhibit cases. The unit can be built by one person and is low in cost.

The dimensions given here can be modified for any given situation, depending on the material to be displayed and the amount of space that is available. The unit was made in four separate parts, with three of the units joined together; the first part, or descriptive panel, was made as a separate unit, movable, for permitting access to the rear for the installation of panels and lights.

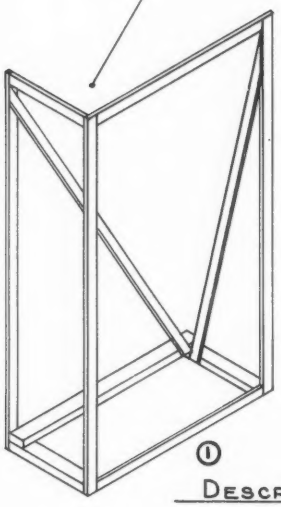
The entire unit stands seven feet in height. All framing was made with "C" pine, one inch by two inches, with the floor frames of standard two-by-fours. The framing was covered with Upson board, three-sixteenths of an inch in thickness, while individual display panels were of quarter-inch Upson board. The Upson board covering was tacked onto the framework with one-inch, seventeen-gauge wire brads. The framework was held together with 4-d box nails, except for the two-by-fours, for which 12-d box nails were used.

The glass for the individual displays was double strength, set into frames, and these frames were built into the unit before the Upson board was applied. The Upson board was brought up to the glass so as to give a front appearance of display cases without frames around them.

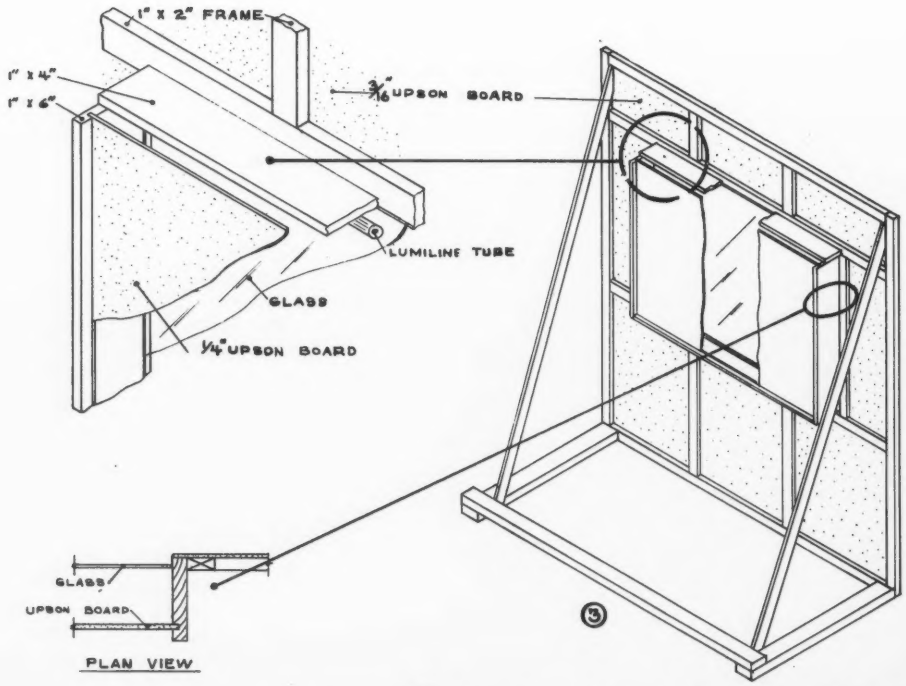
All art work was finished, and the objects to be displayed were attached before the panels were inserted into the slotted holders. If loose objects were to be displayed, the panel boxes could be designed to give access by a hinged back. After the panels were inserted, the bottoms of the display boxes were attached with a single screw on each end. The bottoms were made wide enough to cover the slots to keep the panels from slipping



TOP VIEW



DESCRIPTIVE PANEL FRAME



TYPICAL UNIT FROM REAR

Fig. 1

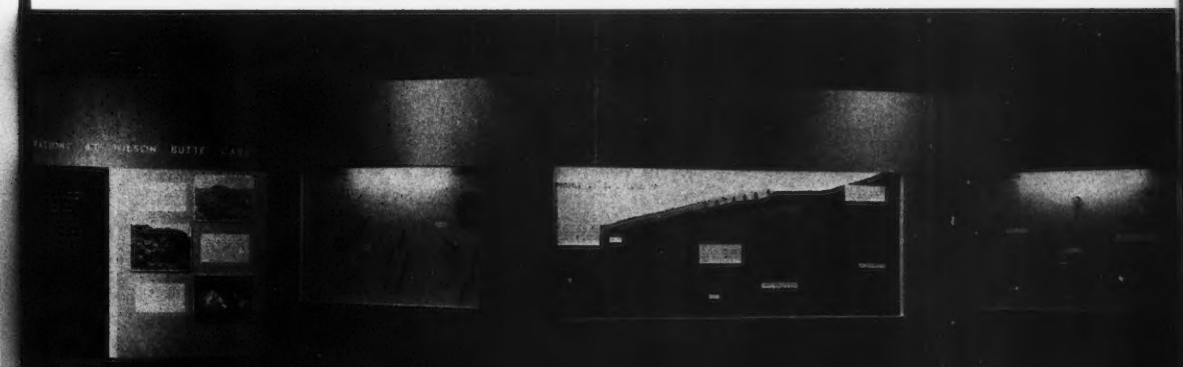
down. The tops of the display boxes, on which Lumiline tubes were attached, were set on and held with a single screw on each end. These tops were raised high enough so as to be out of range of vision of the viewer in front. This left a space above the tops of the panels for ventilation, as Lumiline tubes create some degree of heat. One sixty-watt Lumiline tube was used for each of the two small panels, and three were used for the long panel. As Lumiline tubes do not require a ballast, they are easy to wire. The entire exhibit was painted with one coat of rubber-base paint without a filler.

Our first exhibit, for which this case unit was designed, was entitled "Excavations at Wilson Butte Cave." The title was done with conventional one-inch, white, cut-out letters. Photographs used on the panel were first glued to quarter-inch Upson board, cut to the same size as the photographs, and attached to the panel with small screws on each corner. Labels for the photographs were done with a Koh-i-Noor lettering pen on white paper and glued with rubber cement to the panel. The descriptive text was lettered with white Art-type on a black piece of Upson board, also held onto the panel with screws.

In the glass display boxes, objects consisted of Indian artifacts, cordage, and small wood objects. These were attached to the background panels with bulletin-board wax, and the heavier ones with a combination of the wax and two-pound test nylon leader. Bulletin-board wax can be obtained from some large art stores; and the nylon leader, from any sporting goods store.

The reader is referred to the accompanying photograph and drawings for details of construction.

Fig. 2



The Municipal Museum of Education in The Hague

J. W. B. VAN DER STIGCHEL, FORMER DIRECTOR

INTRODUCTION

The widespread interest created by The Hague's Museum of Education in educational circles throughout the world is due to the important position it has achieved by cooperating with various educational centers within the Netherlands.

The thirty-six years that I was a staff member of the museum were characterized by a series of important experiments which are now being used. It is time to summarize the developments made by the museum up to the present time.

THE MUSEUM'S AIM

The first definite indications as to the museum's aim are to be found in the rules and regulations, laid down by the Society "Het Museum ten bate van het Onderwijs" (The Museum for the Benefit of Education) and published in the *Netherlands Gazette* of January 23, 1905.

These rules describe the museum's purpose as follows: "The Society 'Museum ten bate van het Onderwijs' is founded at The Hague with the object to collect and to maintain a collection of educational items, especially suitable for visual teaching to pupils of different kinds of schools and at the same time giving guidance to their teachers."

It is clear, therefore, that no parallel can be drawn between the aims of this museum and those of other museums. The latter usually collect specimens of artistic and cultural value destined to be carefully preserved for the future. The purpose of the Museum of Education is, on the contrary, to collect, display, and use specimens for the benefit of school children as well as for public education.

HISTORICAL REVIEW

After the museum was founded in 1905, Dr. H. van Capelle, an ardent collector, was appointed Managing Director. The important specimens that he had acquired while traveling served as the basis for the present museum collection which is currently housed in the building on Hemsterhuisstraat 2-E. Originally a school building, it has been transformed into a museum, yet it retains its teaching facilities.

In 1920 the Board was reorganized because the municipality took over administration of the museum.

The first visitors to the museum included school classes touring under the guidance of their own teachers, and adults and children visiting the museum on their own.

Dr. van Capelle lectured on diverse subjects when the museum first opened. Later this task was performed either by his successors or by his trained assistants. I remember from my boyhood days that on one occasion Dr. van Capelle held us spellbound by describing his travels in Surinam. He illustrated his talk by showing us specimens he had collected personally and by playing native musical instruments and singing some folksongs. These memorable hours created a deep interest and love for the museum in me. In later years, when I was Director, they often inspired me to overcome difficulties and failures in order to achieve the final results.

EFFORTS TO MAKE MORE PRACTICAL USE OF THE COLLECTIONS

The manner in which the collections were exhibited show that Dr. van Capelle tried to use a definite working method. Those who followed him, however, succeeded in developing a more efficient and better planned way of visiting the museum. They tried to popularize it by organizing attractive exhibitions on a large scale, thereby providing a way in which the collections on hand could be used to increase men's knowledge on a given subject in more than one way.

THE COLLECTIONS ARE GROWING

As a museum grows in popularity, a great number of collections are received as gifts or as loans. The greater part of the gifts received by the museum consisted—and in fact they still do—of unique specimens that were accepted with great pleasure. Although these exhibits had nothing to do with the actual work of the museum, they serve to make it more attractive to the public, and they enable us to assemble material for still more lessons on new subjects.

Indispensable items and materials that were needed for visual education were purchased, or made by the museum staff if they were not available. During the lectures the pupils are shown not only specimens taken

Fig. 1

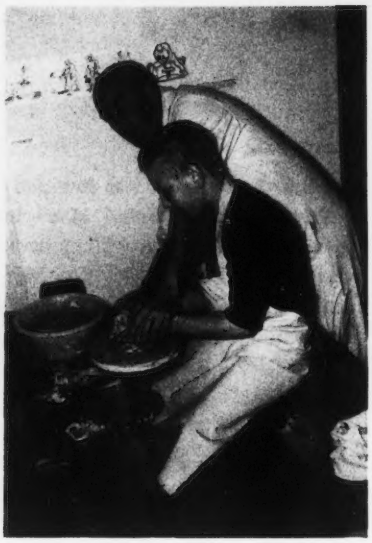


Fig. 2

from the museum but specially designed models made in the museum workshops, such as filmstrips and slides.

A number of specimens are kept in museum show cases in the event that they will be needed in the classroom. It is regrettable that so far no adequate location is available in which the pupils can examine and study items on their own during their spare time.

After a lesson is over, pupils add to their knowledge by visiting areas in the museum which contain specimens that have been mentioned in the lesson but have not been shown.

As participation in the lessons increased, the number of available classrooms became insufficient and it became necessary to give lessons in museum rooms which had been transformed by installing display cases and by equipping the room with a screen and a film and slide projector. An attempt was made to bring the museum lessons to the children in their classrooms. As transportation to and from the schools must be by car, only lessons requiring little material—not too fragile—can be given outside the museum.

METHODS OF TEACHING

The first lessons given to visiting school classes were held in the exhibition halls housing the collections. Later, lessons were given in separate classrooms because the arrangement of specimens in display cases was not always adapted to the lessons given, and teaching proved unsatis-

Fig. 3

Fig. 1. Entrance view, showing the ceiling-to-floor exhibition and storage cases. An elevator takes classes to the museum's four teaching floors.

Fig. 2. A museum ethnologist demonstrates with the actual Indonesian materials how Indonesian women prepare rice.

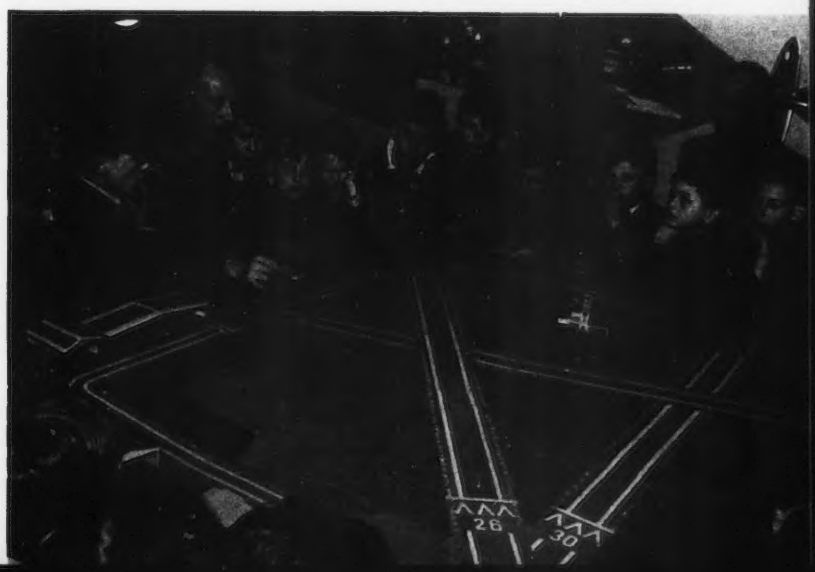
Fig. 3. Museum collections are kept in easily accessible show cases so they may be removed for use in the classrooms.

Fig. 4. Classroom instruction is supplemented by actual practice, as shown by this demonstration of the art of pottery making.

Fig. 5. The aviation exhibition led to classroom instruction on the actual operation of a busy airfield.

Fig. 4

Fig. 5



factory. When it is possible, the seats are arranged as in an amphitheater, and a demonstration table holding the specimens needed during the lecture is placed in front of the seats. They are kept on the table without the students knowing it, but are arranged in a way that enables the teacher to place them in full view on the bench as they are needed. Every time a specimen is brought forward, the children are surprised.

The children attend the same lesson in the museum that is currently being taught in their schoolroom. They are, therefore, expected to have some knowledge on the subject so the museum lessons can serve as a visual supplement and a general review.

Teaching is done by their own form-teacher or, on request, by a museum teacher. It has been customary since the museum was opened to leave the teaching to a museum expert. This results in a waste of time because he must test the pupils' knowledge on the subject being discussed before the lecture can begin.

At the present time students can choose from more than sixty subjects dealing with biology, physiology and hygiene, geography, ethnography, ethnology and prehistory, physics, geology, a series of excursions to industries, and biological field work.

Traffic education is given by policemen in a traffic garden equipped with a model main street crossing complete with tramway, automobiles, and traffic lights.

These lessons can be adapted to the age and educational background of the pupils so that not only the primary and secondary school pupils but even college students and those attending advanced technical schools can benefit.

ORGANIZING SCHOOL CLASS VISITS

At the beginning of every school year a list of the subjects to be covered is distributed to schools so that the teacher can choose which ones he wants to attend. He is given application forms to fill out which admit his class to the museum, and he must state the hour and date he wishes to visit the museum, so the children can hear a subject discussed that is being taught in their schoolroom. The children are thereby able to follow the demonstrations more easily.

Fig. 6. Traffic school for Dutch children. A. Stripped-down automobiles are used to acquaint Dutch children with proper driving procedures in a crowded city. B. By the time a boy or girl is old enough for a driving permit, he or she has been well indoctrinated in safe driving. C. The museum's garden is the laboratory where children learn the importance of obeying traffic laws, particularly when they will be riding bicycles most of their lives.

Fig. 6A

Fig. 6B

Fig. 6C

The visits and lessons for school classes are entirely free of charge to all schools and institutions within the municipality of The Hague, as the museum is a municipal institution. Transportation by bus for the children is also paid for by the municipality. A week in advance an advice card is sent to the school stating the exact hour and date the lecture will be held along with a bus schedule. This system gives the teacher ample time to make sure that his class is prepared in every respect to follow the museum lesson to its best advantage.

ORGANIZING EXHIBITIONS

A very interesting job in the museum is planning the specialized exhibitions which have attracted a great deal of attention. These exhibits, which promote interest in community life, include displays about the municipal works of the city, public services promoted by the local authorities. The exhibition "Means of Traffic" began with "Aviation" and was followed by "Navigation" and "Railroad Traffic." Part of this exhibit was held over more than a year because it proved to be so popular. In the museum's constant endeavor to modernize teaching methods, these exhibitions are of great importance, as they facilitate study and instruction by providing educational material.

MUSEUM INSTRUCTION TO SICK AND BLIND PEOPLE

We eventually realized that children and adults who were hospitalized or confined to a sanitarium for a long period of time would be unable to benefit from the museum. So the museum, in cooperation with the local hospitals, decided to bring specimens to the patients. The teachers are thereby able to deliver illustrated lectures. They are generally given in the wards, with the patients lying in bed, but are occasionally held in special lecture rooms. Ample time is allowed blind patients to examine the specimens, which are sometimes specially made for them, by handling them. They can therefore pursue knowledge in their own way. Excursions are held in the open so they can study bird song and the form and smell of flowers. The lessons affected the patients in two ways: it increased their general knowledge, thereby improving their psychic state which often speeded their recovery.

RECORDS OF VISITS

Every year many thousands of pupils from various schools and educational institutions visit the museum after the lectures along with the people who visit during their free time. In 1948 the museum had 115,296 visitors. By 1950 the attendance had reached 164,787 visitors for all age groups. In 1960 out of a total of 197,110 visitors, 130,686 were pupils, 5988 were teachers, and 60,436 were individual visitors.

THE MUSEUM AS A SCIENTIFIC INSTITUTION FOR PUBLIC EDUCATION

The museum has a second, no less important, task, namely, general public instruction. The comprehensive collection of the museum is arranged so as to be as representative as possible, although it would be better if the specimens could be displayed to show their relationship to one another, thus demonstrating their meaning to human life. At present this is unfortunately impossible owing to a lack of space. The museum, however, does contain a wealth of material which is well arranged and always on hand for self study. These specimens form an important contribution towards acquiring extensive general knowledge. To give a detailed review of all the items displayed would take too much space, yet a concise summary of the different departments will give a rough idea of the collection as a whole. There is an extensive collection of both fresh-water and salt-water fishes from Holland and the North Sea. Beside it are a large number of tropical specimens which are interesting because of their shape, color, and special economic importance.

The zoological collections contain a nearly complete collection of European birds. The Dutch specimens are shown with their eggs and the young in various stages of growth. In addition there is a beautiful collection of European exotic shells and butterflies.

The ethnographical section portrays the spiritual life and art of people in different parts of the world, including tropical and polar regions. Special mention should be made of the rich collection of Greenland Eskimo objects, including the beautiful clothing, objects made of driftwood, animal bones, and teeth which are used for household purposes, hunting or religious services.

Collections of stones, fossils, semiprecious stones, and models of gems are found in the geological collection. The models that demonstrate oil fields, specific parts of mountains, glaciers, and so on are made in our own workshop.

The exhibit concerning the human body contains complete skeletons, models of various parts of the human body, specimens mounted in fluid, and a series of demonstration preparations treating the sanitary science.

Both historical and very modern instruments demonstrate the laws of physics. Some demonstrations even give the proof of some theorems which have been published but never proved.

There is a prehistoric collection of models, mounts, stone axes, and pottery primarily from the Netherlands and other countries in Europe, but there is also a fine collection of ancient Phoenician and Roman pottery from North Africa made by one of the curators of the museum. In addition a specially arranged series of prehistoric human skulls of primates afford ample material for discussions on the heredity of man.

Finally there are the valuable herbaria, containing a wealth of dried

Fig. 7. One of a class for the blind examines a herring gull. Later, the instructor will take the group on a field trip where gulls may be heard as well as touched.

Fig. 8. Children are encouraged to take active part in classroom instruction, including the handling of specimens.

flowers and plants, which have retained their original color. Not only is there an herbarium of plants from the gardens, woods, and parks of The Hague but even one from Canada and some parts of India.

FILMS AND SLIDES

During the course of years, the demand for educational films has increased considerably. The Netherlands Educational Film Foundation can only partly meet the demand from the primary schools. Therefore a separate service had to be formed within the museum organization. Filmstrips as well as projectors can be obtained on loan. Needless to say, extensive use is made of this museum service. A system of distributing films for more advanced educational institutions was recently begun, meeting a great demand.

THE MUSEUM AND PUBLIC CULTURE

Because everyone is not capable of profiting to the same extent by visiting the museum, conducted tours in certain sections of the museum are now held at fixed hours. An expert gives the tours, which are usually preceded by an introductory lecture with slides to give the visitor a clear general view of the subject to be discussed.

The more general cultural activities held during the winter season include film shows which are preceded by a short introduction.

I hope I have made it clear that the Museum of Education in The Hague is, on the one side, a museum like any other museum, but that it has assumed a special task in the educational and cultural field by giving visual instruction in the widest sense of the word to people of all ages and educational backgrounds.

Fig. 9. An interested pupil shows intense concentration at the showing of a teaching film used to point up instruction.

Fig. 1

The Money Museum of the National Bank of Detroit

OSCAR H. DODSON, DIRECTOR, AND
THEODORE E. LUDEROWSKI, PROJECT HEAD FOR DESIGN

Everyone is interested in money. Few men feel that they have enough of it. Since the appearance of the first coins in western Asia Minor in the seventh century B.C., these tiny metallic symbols have fascinated mankind.

In the United States, the current surge of interest in coinage is two-fold. Inspired by news reports, which are often incorrect or misleading, that a fortune may slip through his fingers, the man in the street carefully examines his small change for rare mint marks or for mis-struck coins. Even more significant, numismatics is commanding a growing interest among scholars. The study of coins as personal documents, neglected for centuries, is at last assuming an importance that it has long deserved. Coins, like ancient manuscripts, constitute a primary historical source. Uncounted hoards of old coins still sleep within the earth patiently awaiting the farmer's plow or the spade of the archeologist. As these hidden treasures of ancient men are uncovered, their study, cautiously evaluated, sheds new light in the fields of history, archeology, economics, art, architecture, and biography.

It seems fitting that in the new, downtown main office of the National

Fig. 1. Entrance to the Money Museum, showing one of the sliding gates, which are constructed of aluminum bars and small marble discs which are framed in gold anodized aluminum rings.

Fig. 2. The mounted Yap stone money on the main banking floor.

Fig. 3. Floor plan of the Money Museum of the National Bank of Detroit.

Fig. 2

Bank of Detroit a museum devoted to the story of money is included. This museum began as a collection acquired through years of intensive effort by Nate S. Shapero, prominent Detroit merchant and philanthropist. The museum is completely devoted to numismatics in the broadest sense of the term. The collection, remarkable for its diversity, consists of more than 12,000 items. Permanently on exhibition are a representative display of ancient, medieval, and modern coinage and an extensive exhibit of

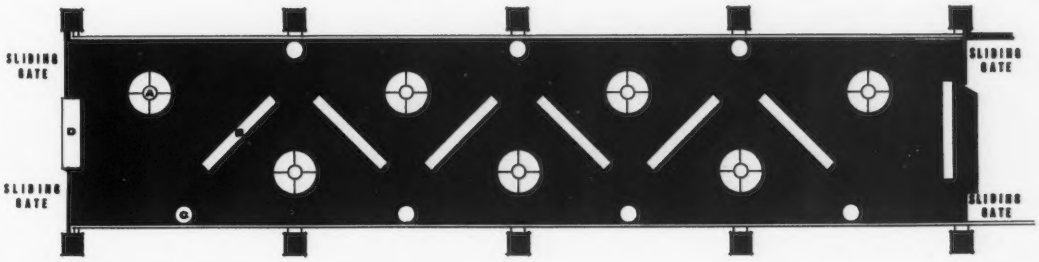


Fig. 3

Fig. 4

paper currency. With few exceptions, the collection is complete in coins issued by the United States mints.

In two special fields, the collection is truly notable. Mr. Shapero's wide interest in precious metals is reflected in a magnificent display of gold coins, including many pieces of great rarity. Also of particular interest is the exhibit of primitive media of exchange, gathered from peoples the world over. On display are pieces of ancient jewelry—bracelets, rings, pins in gold, silver, and copper; early trade bars in silver and gold, and ceremonial and ornamental carvings of Chinese jade. The teeth of the dog, porpoise, shark, and sperm whale; wild boar tusks and shell curren-

Fig. 4. Solution of display problems: foreign coins in round case; early American media of exchange in left vertical case; Japanese money trees in cylindrical case; and United States currency in right vertical case.

Fig. 5. General view of the exhibition, showing the three types of display cases.

cies from Polynesia; spearheads, hunting knives, ceremonial axes, and bricks of salt from Africa; wampum and trading implements in copper and gold from the early cultures of the Americas—all these highlight the historical and economic achievements of man.

What aims and program enable this specialized museum to make a contribution to the community? In the wide variety of numismatic material on display, each age group finds areas of special interest. The elephant tusk and monkey tail, valued in Congo trade, and the huge stone coin from distant Yap Island evoke excitement from Cub Scouts and Brownies. Pieces of Eight of pirate fame, the United States $10,000 bill, rare American gold coins, and the modern coinage of member states of the United Nations prompt questions from high school groups. College students closely examine the Babylonian clay tablets, coins used by men who built the Parthenon, or fought under Alexander, or served the empire under Nero. Students are somewhat overwhelmed in discovering that coins have been continuously issued for twenty-five centuries.

Adult visitors who expect to find rows of dimly illuminated, heavily loaded exhibit cases lining long walls are refreshed by the airy spaciousness of a museum without walls. Others marvel at the unexpected scope of the displays, with every culture and civilization represented. In addition, many have been attracted by the brightness of the museum area, the harmony of color in the unique display cases, and the effort to enhance each specimen by limiting the number, rather than displaying everything possible.

The museum is planned to appeal primarily to students—to stimulate in young minds a greater interest in our cultural and political heritage.

Only a knowledge of the past will enable our young people to understand today's changing world and to plan intelligently to insure peace, liberty, and prosperity in the century ahead. But most students approach history with a sense of misgiving, if not dread. Ancient men are vague, shadowy, useless beings who built colonnaded temples, chiseled marble statues, drove chariots, and wrote on clay or papyrus—all alien to the everyday

Fig. 5

life of our youth. Coins, on the other hand, are an intimate part of daily experience. A display of ancient coins cuts through the span of time, bringing the past to life. The student discovers that the streets of Athens, Byzantium, Rome, and Carthage were trod by men of flesh and blood, men who faced (and frequently solved) problems similar to those of today. Here coins and primitive trade articles bring into focus the miracle of human progress.

A museum constructed solely for the display of widely diversified numismatic material offered an exploration into many new possibilities in museum design.

The first step in the design of this museum was a thorough examination of the collection itself. The second step involved a study of the physical area in which it was to be housed. The third phase consisted of detailed, explorative experimentation in the search for ideal systems for the display of single coins, groups of coins, and the various other two- and three-dimensional odd and curious pieces in which the collection abounds.

The collection is composed of a great many coins of all varieties mounted in plastic plaques of various sizes containing single coins or groups. Some coins are not mounted. Generally occupying about the same area as the coins is the "odd and curious" collection. This part of the collection contains a great variety of objects used as money or in barter. This includes pieces of stone, shell, glass, porcelain, and ivory, lumps of gold and silver, beetle-leg necklaces, heavy pieces of copper plate money, bricks of pressed tea leaves, Japanese money trees, Indonesian drums and marriage knives, Indian wampum, and heavy, Congolese metal bracelets, anklets, and necklaces. A third portion of the collection consists of paper currency of all types.

The exhibit area is a handsome, bridge-like mezzanine, twenty-two by one hundred feet, which connects two portions of the bank and is conveniently serviced by elevators and escalators. Its long sides are contained by a stainless steel and teak railing. The mezzanine enjoys a prominent position in the main banking area and can be seen from the main floor and from the street. The floor of this area is covered with dark blue carpeting which is a continuation of the adjoining bank areas. The ceiling is acoustical plaster, with a regular pattern of down lights. Carpeting, acoustical plaster, and lighting were already completed before the design of the exhibit was started.

In the third phase of design, exploration was conducted to establish greater clarity and flexibility in display properties and to establish ideal conditions for viewing so many diversified objects. To a great extent, the subject matter in this collection from the visual point of view is definitely in the realm of a fine arts collection. Fine sculpture appears everywhere in reliefs on coins, in the shape of primitive Yap money, Chinese spade

money, and brick tea money. There is also a fine display of design, invention, and function in most of the objects of the odd and curious section. Indeed, the viewer is somewhat hard-pressed to find "bad design" in the collection whether primitive or contemporary. In short, it is not only an interesting record and collection of money from the point of view of the numismatist, but it is also an "Art in Money" exhibit as well. It was believed that interest in this show would be three-fold: first, as a money museum concerned with the completeness, superb condition, and rarity of numismatic items, and the historical implications of coins, medallions, and paper currency; second, the great interest generated in the odd and curious section; and last, but not least, the fascination of a unique and pleasing design which prevails throughout the collection.

When the collection is considered from the many points of view of display, certain approaches became evident. It was decided that display properties of whatever design should not touch the ceiling but should "grow" out of the floor. This would preserve the light, floating effect of the mezzanine. The numismatic subject matter itself required many different physical conditions for display. There was need for vertical, two-dimensional areas, horizontal areas, shelf areas, three-dimensional areas, and systems for suspending objects. Above all, the primary requirement was flexibility, particularly within the cases themselves. The objects to be displayed numbered in the thousands, and experience dictated that more effective displays are organized "on the job" (composing, arranging, and modifying directly in the case), rather than by the "designed on the board" approach. This plan is better and actually faster, but it depends completely on a display system that has great built-in flexibility. This flexibility aids not only the designer in the initial installation of the objects but simplifies the job of arranging future shows by a non-designer museum staff charged with this duty. A combination of squares, rectangles, circles, cantilevered Plexiglass shelves, hanging devices, and "pin on" color areas creates proper display backgrounds. These devices are removable or reversible and are in four colors that are related to one another in value. They can be manipulated to create infinite compositions in two and three dimensions as required for any specific display effect.

The final solution of the display problem resulted in three types of exhibit cases which are illustrated in the accompanying photographs. These three types take care of all the display conditions that are outlined above. The combination of vertical and horizontal cases, together with pierced areas in vertical cases, relieves any monotony and creates an interesting change of pace. The supports for all cases are cast-iron bases of mushroom type, with fused-on paint. This type of base permits cases to be free standing and eliminates a forest of legs or heavy supporting rectangular bases. The general effect is one of lightness and simplicity.

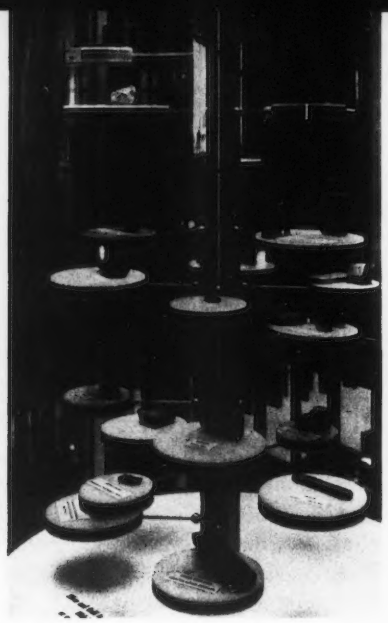


Fig. 6

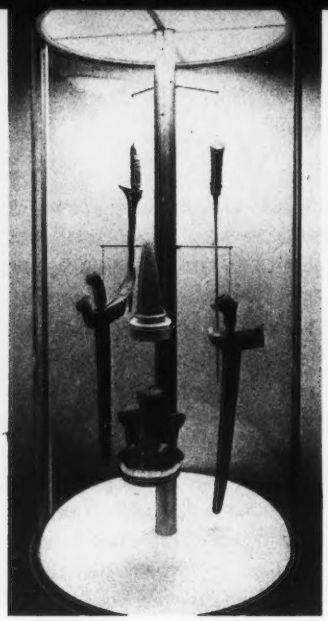


Fig. 7

There are seven units of each type of case for a total of twenty-one units. The illustrated plan shows an arrangement designed to be seen chronologically by walking along one side and then the other. The spectator with no interest in the chronology may short-circuit the route at any point.

The three types of cases are related to one another in height, with the apron or lower platform the same height for each case. The top of the vertical and cylindrical cases are also the same height. The colors inside the cases, gray, blue, gold, and red rust, are used to enhance each object that is displayed.

Each case is individually illuminated with fluorescent slim-line lamps. In the vertical cases, the "open through" area provides maximum depth and height for large objects. This "hole" also provides the spectator with a "teaser" in that, as he looks through, he begins to see bits of other areas of the exhibit. The cylindrical cases were designed for the display of

Fig. 6. From earliest times gold and silver in ore and bars have kept the world's trade flowing. The small disc platforms can be arranged in many ways to solve a particular display condition.

Fig. 7. Indonesian bridal knives, a Babylonian clay cone, and a Japanese "piggy bank" in cylindrical case. This display shows the disc pedestals and cantilever bars used in combination.

Fig. 8. Eskimo and American Indian artifacts and trade articles in vertical case. The use of removable, felt-covered discs and inserted plastic shelving is well illustrated here.

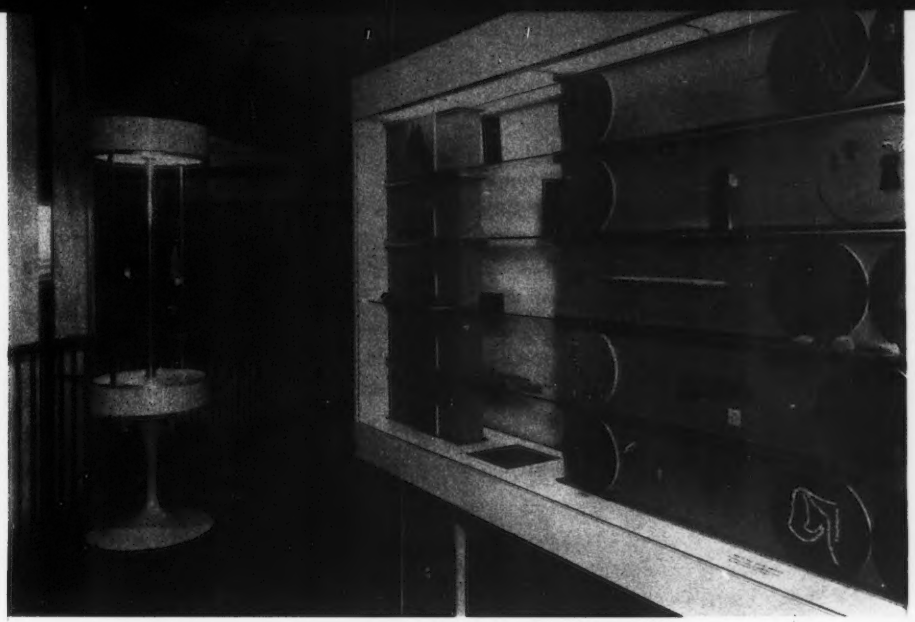


Fig. 8

objects generally having sculptural qualities, objects that require space around them, or those to be suspended in space.

All cases are covered with white, matte finish formica. The cast-iron bases which support all the cases are anchored to the concrete slab. All electrical and burglar alarm wires are run through the bases.

The entrance to the Money Museum takes the form of a marble panel approximately eight by nine feet. Mounted on it is the museum name in bronze letters and an enlarged casting of the famous Victory Decadrachm of ancient Syracuse. The reverse side of this introductory panel contains additional display area and storage. The enclosing security gates at both ends of the museum are constructed of vertical aluminum bars intersected by small marble discs in a simple pattern. The gates at the entrance slide into a slot behind the marble panel and are thus completely out of the way during the hours when the museum is open.

In addition to the museum display, there is on the main banking floor a special display which consists of one large specimen of Yap stone money some five feet in diameter and weighing 870 pounds which is secured in a special mounting. On Yap Island in the Western Caroline Islands, South Pacific Ocean, these huge stones are used as ceremonial gifts for honor and tribute, as well as in payment for house and canoe building, in arranging marriages, and in exchange for land and reef use rights. They are the symbol of the wealth of a family or a village. This particular stone is the largest specimen ever to have left Yap Island.

Since it was opened to the public on May 1, 1960, more than 50,000 people have visited the Money Museum.

The Importance of Being Public

A. E. PARR, SENIOR SCIENTIST
THE AMERICAN MUSEUM OF NATURAL HISTORY

The many voices speaking up in protest against the dreary museum offerings of the nineteenth century, still surviving in many exhibition halls even today, have with great and exceptional unanimity seized upon the transition of the museums from private collections to public institutions as the pretext for their rebellion against tradition. It is claimed as self-evident truth that an institution supported by public funds must in return be of service to the entire public without selection or restriction.

According to Wittlin,[1] "the public museum being a civic institution, the justification of its existence should be measured by its capacity to serve the needs of the people." From this premise Miss Wittlin, one of the most forceful exponents of museums for the masses, gradually leads on to the conclusion (p. 186) that "the first and main function of the public museum is to aid the adaptation of great masses of people to an environment characterized by an unprecedented rate of change in all conditions of life." Although the present writer has been advocating the avowal of a similarly conceived purpose for natural history museums for more than twenty years, he cannot accept the current trend of thought that would construe such a function as an inescapable and unequivocally defined obligation of repayment for public support. Since even true conclusions, as long as they rest on false premises, lend weakness rather than strength to any cause, however noble, an examination of the importance of being public, and a search for other indicia of our true mission may be worth our while.

The most casual glance at the theories and practices of other civic establishments will suffice to reveal the total lack of foundation for the widely encountered, though only vaguely implied notion that being public means having a duty to be of direct and immediate assistance to

[1] Wittlin, Alma S., "The Museum, its History and its Tasks in Education," London, Kegan Paul, Trench, Trubner Co., p. xiii, 1949.

every person who may feel a craving to experience the services the institution has to offer, regardless of the individual's reasons for wanting what he seeks or his ability to use what he is after. Even public hospitals admit only the sick. Public housing offers its benefits only to applicants selected according to economic circumstances, size of family, or other special considerations. Public universities do not overlook the educational prerequisites normally demanded of university students. Public archives have become a feature of virtually all countries, but none would expect them to receive and to wait upon throngs of casual visitors. These civic institutions serve the "great masses of people" only indirectly through the usefulness of the services they offer particular groups, often quite narrowly defined by their special skills or special needs.

The fact that a museum is public is, therefore, in itself no evidence whatsoever that it also has to be popular in the sense that it has to address itself to some common denominator for the needs of the greatest random mass of people that could find room within its doors. On the contrary, it might very well be argued that a civic institution, for the very reason that its entire existence depends upon the approval and support of the people or of their chosen representatives, would have every right to function within audience limitations that, if they were enforced in a privately controlled establishment, today would be taken as regrettable evidence of a lack of public spirit. A public museum for the exclusive use of specialists is much more easily justified than a privately maintained establishment operating with similar restrictions under all the legal advantages of charitable status.

Two factors have tended to lend misleading credibility to the argument that the museum, when it accepts public support, by that very act commits itself to a program that must forever after take its aim at great and random masses of people. Because it is completely impractical to establish tests of admission to a general public museum, a curator sensitive to his obligations as a host becomes predisposed to believe that he must do something for all levels of education and of intelligence, since they may all be found among his guests. Secondly the problem does not solve itself as it would in a school. Although the schools close their doors and count their pupils before their day begins, it is highly unlikely that they would experience any unwanted surge of attendance in their classrooms if they neglected to take these precautionary measures, which are disciplinary rather than discriminatory, aimed at securing the orderly presence of their pupils rather than the absence of others. A person of knowledge above the teaching level of a class, and one whose knowledge is yet below it, would both be equally bored by the experience of drifting into a classroom session and would very quickly fade from the picture. The writer has himself had opportunity to attend university courses with

lectures open to anyone who might care to enter. There would almost invariably be one or perhaps two visitors not belonging to the student body. But these were persons with a real interest in what was taught and the ability to benefit from it whatever their circumstances might be, and no problem ever arose from the unrestricted admission of the public. This self-selective process of the classroom and lecture hall is based upon the individual's ability to enjoy verbalized communication on a certain level of sophistication. But in the museum verbalization is entirely secondary to the direct observation of objects that can be equally clearly seen by all and enjoyed by each in his own fashion, regardless of ability to read or make sense of labels and symbolic messages. Behind the thoughts of the makers of museum policy there must, therefore, always be an awareness that when the doors are opened to any and all, any and all will enter. This awareness offers fertile soil for the growth of a diffuse sense of universal obligation for which the real reason is not to be found in the mere acceptance of public support.

If our duties are not prescribed as mandatory obligations of trust, arising by self-evident logic from the manner of our support, it becomes necessary to seek other bases for the definition of our responsibilities. The fact that our exhibits have some message for all who see them, regardless of knowledge or intelligence, now takes on a new meaning and becomes a true premise for further reasoning, instead of being merely a partial explanation of erroneous conclusions drawn on other grounds.

The concept of duty is an ethical concept. Unfortunately, or not, our ethical principles are not capable of deduction and proof by the simple methods of scientific procedure. However, the proposition that ability and opportunity to be of service create an obligation to serve is one of the most firmly held canons of modern morality. And the less we share with others our special capabilities and circumstances, the more compelling are the demands they place upon ourselves.

Among all educational institutions those that communicate primarily by the display of objects and replicas, rather than language and symbols, are the only ones capable of conveying a message to all who come, without being under any necessity to grade their audiences and offer separate lessons for each grade. From this it follows that those who teach by exhibits are under an inescapable obligation to serve as a mass medium of general public education in addition to any special educational functions they may also perform.

With this conclusion we have not come full circle to re-establish the proposition we first rejected. The obligations derived from ability and opportunity devolve equally upon all establishments, whether they are entirely sustained by private means or entirely supported by public funds. Our duties are not defined by the manner of our maintenance.

No generalization as broad as the one here propounded can be without exceptions. Exhibits or entire museums for restricted audiences are fully justified in order to meet particular group needs and interests not shared by the general public, when acquaintance with the material on display would be obviously or demonstrably harmful rather than beneficial to those not properly qualified to receive the information conveyed. Outstanding examples are museums of criminology and advanced exhibits of human pathology for the students and practitioners of medicine. It is notable that the justifiably restricted museums that most readily come to mind fall into the category of public rather than private institutions, as already above indicated.

Since we live in an age when idealistic definitions of duty or of anything else are not in the height of fashion, and are often heavily discounted, it may be well to re-evaluate our conclusion from the purely selfish point of view.

The image of a conflict between idealism and realism is generally only an optical delusion of those with a myopic vision of both. If the general museums of the sciences, the arts, and history were to reject their obligation to serve the general lay public according to its actual educational needs and interests, or were to fail in the task through incompetence or, what seems more likely, through dogmatic insensitivity or indifference to the real demands, one of two alternative consequences would ultimately follow. If the demand were real and continuing, new institutions would sooner or later spring up to fill the gaps left by those preferring to serve a narrower purpose, representing their own rather than the public interests. The older institutions would then gradually find their sources of support essentially limited to the special and private interests they serve, with little access to the public coffers on which the new establishments could easily prove a higher claim. If however, new institutions did not come into being it would, in the circumstances, create a strong presumption that the educational services which could have been offered by the old museums, but were not, cannot have been very essential to begin with. Since failure to find satisfaction for a genuine interest tends to bring about its decline, a disregard of our opportunities to be of service may often reduce the demand for the services we are able to offer if we subsequently try to turn a new leaf. The realistic penalties for neglect of our idealistic obligations are therefore likely to mean losses both in public esteem and in public support.

This may sound like seeing ghosts where none exist. But the writer is convinced that a lack of response to changing trends of public interest and genuine educational needs is the main cause of the hard times that have befallen so many of the older museums of natural history in all parts of the world during the last three or four decades. Several of these

institutions have in fact disappeared altogether, both here and abroad, and others linger on in relative obscurity compared with the glory of their earlier days, at the same time as new institutions devoted to the same subjects, but with a different orientation towards their task, may appear within short distances from the site of one that fell, and museums of art, ethnography, and history multiply and prosper as never before. In the acceptance of our idealistic obligations there is realistic strength; in the neglect of our ideal opportunities there are only weakness and lost chances. For the sake of our sordid necessities, let us therefore not be misguided by our own preferences into an early decline, but let us seek better guidance from the needs we are able to sense in others.

IV/3 1961

Aspects of Design of Exhibitions and Museums

HERBERT BAYER

In the present article I give attention to some of the more fundamental ideas as they have crystallized in my concern with the subject of exhibition design and as I see them now, partly in retrospect. It is also my intention to shed light on the history of some of the innovations that today are integral parts of a design language for exhibitions and museums.

Exhibitions are usually designs in space. As such, architectural elements define the major spaces and serve the structural requirements. The elements of communication and display must be incorporated and integrated into a scheme that conforms to a desired sequence of impressions and to the visitor's abilities of perception. The organization of the floor plan should insure an uninterrupted flow of traffic and permit and induce the visitor to view all exhibits.

The designer's aim here must be to improve and to intensify communication. The human being is mercilessly exposed today to a never-ending attack of influences, messages, and impressions. We cannot readily reduce the quantity of these attacks, but we must learn how to concentrate the messages, how to omit the non-essential, and, above all, how to improve our techniques of communication.

Exhibitions are, generally speaking, of a temporary nature. They are often of an experimental character. Their content may vary from a presentation of the beer industry to the history of transportation to mankind's religious aspirations. There are commercial exhibitions; there are educational and cultural exhibitions; museums with special problems of presentation; and art exhibitions. There are street-window displays and trade fairs. Each of these categories poses different problems and demands different handling.

Exhibition design has evolved as a new discipline, as an apex of all

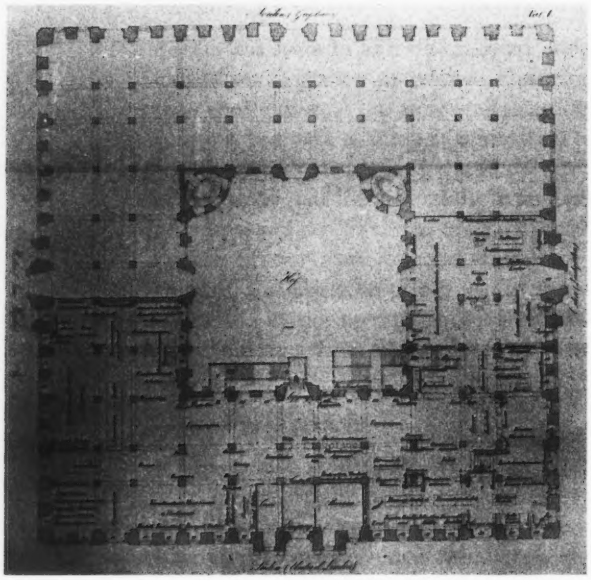


Fig. 1. Floor plan of exhibition in Berlin in 1844.

media and powers of communication and of collective efforts and effects. The combined means of visual communication constitutes a remarkable complexity: language as visible printing or as sound, pictures as symbols, paintings, and photographs, sculptural media, materials and surfaces, color, light, movement (of the display as well as of the visitor), film, diagrams, and charts. The total application of all plastic and psychological means (more than anything else) makes exhibition design an intensified and new language. It becomes integrated use of graphics with architectural structure, of advertising psychology with space concepts, of light and color with motion and sound. To play successfully with this modern instrument of possibilities is the task of the exhibition designer.

ORGANIZATION OF THE FLOOR PLAN

In an exhibition in the newly opened Zeughaus, in Berlin, 1844, it was evidently deemed necessary to guide the visiting public along a predetermined path. Lacking other means in the rigidly symmetrical museum building, the visitors were moved in the desired direction in a Prussian soldierly fashion, by spoken commands.

The first attempt to organize an exhibition space was made during the World Exhibition of 1867 in Paris. The exhibits were arranged on an oval floor plan with corresponding galleries. This organization of the interior was expressed in the architecture of the building.

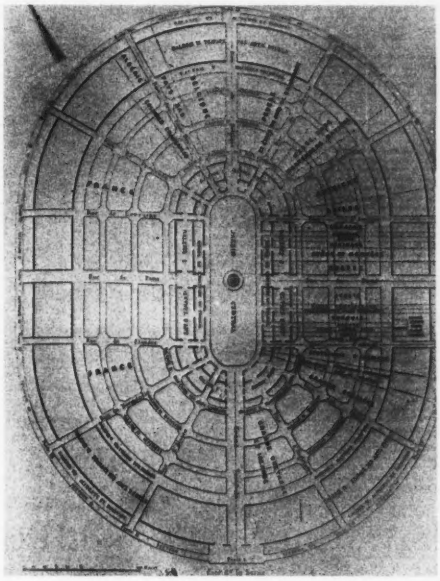


Fig. 2

Fig. 3

Figs. 2 and 3. Central oval building at the World Exhibition of 1867 in Paris.

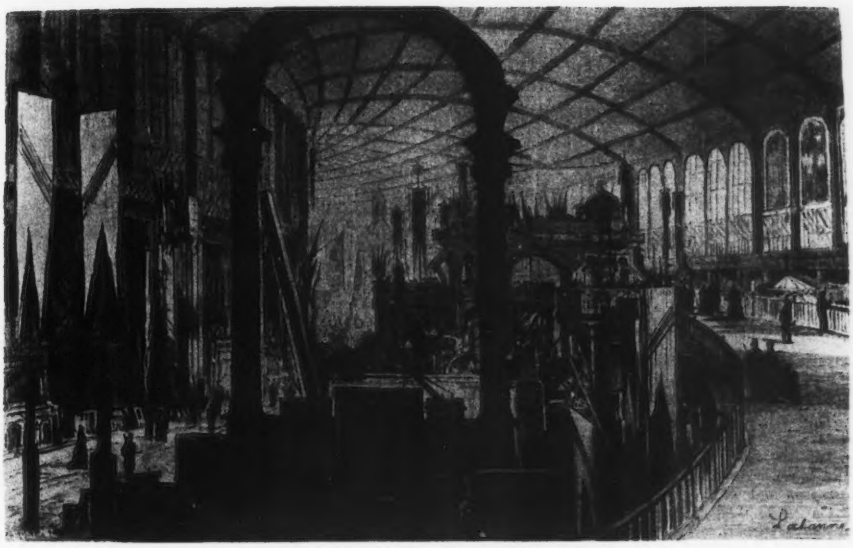


Fig. 4. The gallery of heavy industry, World Exhibition of 1867 in Paris.

Many years later, in a typical exhibition hall in England in 1935, we observe that the need for an organic floor plan had not yet been recognized and that confusion still prevailed.

The isometric drawing of an exhibition in 1936 in Berlin exemplifies the fact that symmetry still was an effective medium towards order, but, employed to produce an organic traffic flow of the visiting public, the symmetry appeared too rigid and inflexible.

Figure 7 from the same exhibition, on the other hand, is an example of an asymmetrical floor plan of displays arranged freely. It is equally inadequate, as orientation and direction are absent.

Two simple diagrams make the difference between disorder and an organized flow obvious. They suggest that designs for museums and exhibitions must, at an early stage of planning, cope with the problems of traffic control.

One of the first attempts known to me to organize an exhibition according to an organic flow and sequence of exhibits was in the German Werkbund Exhibition in Paris in 1930. A serviceable plan of circulation proved difficult here, as the use of space, cut up into several rooms, was conditioned by the old building in which the exhibit was housed (Exhibition des Arts Decoratifs, Grand Palais). An exceptional feature was a bridge (by Gropius) over which the circulation flowed and from which one gained a bird's-eye view over part of the show (collaborative exhibition design by W. Gropius, H. Bayer, M. Breuer, Moholy-Nagy).

Added fluidity was introduced by a curved wall, as the diagram of figure 9 demonstrates. This was effectively utilized as a new feature in the exhibition above, by Moholy-Nagy.

Similar principles were carried out successfully in the exhibition of the Building Workers' Unions in Berlin in 1931. A more elaborate bridge was introduced here to raise the visitor to a higher level for an over-all view of the entire space. Viewing from above provided the opportunity for the design of special displays. Figure 11 shows a general view of the bridge and the exhibits. Many new techniques were developed for this project.

The movement of the public in a planned direction was the central theme of the plastic concept for the exhibition "The Community" in Berlin in 1936. The model shows the special form and space concept created by exploiting the idea of circulation. The exhibits were placed on large overhead panels under which the visitor passed towards the core of the exhibit.

An exhibition, "Bauhaus 1919–1928," was staged in temporary quarters of the Museum of Modern Art in New York in 1938. The experiment was made here to suggest walking directions with directional and decorative shapes and footprints painted on the floor. The sequence of the exhibits

continued on page 264

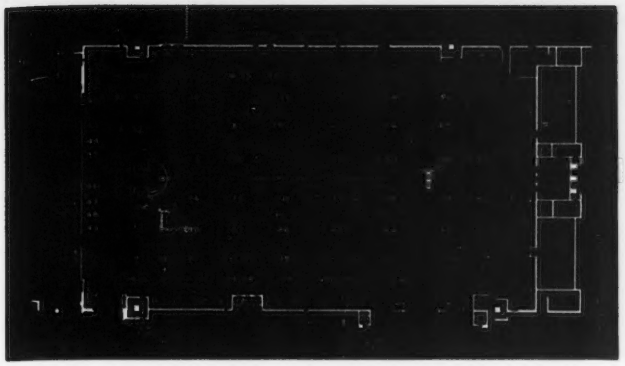


Fig. 5

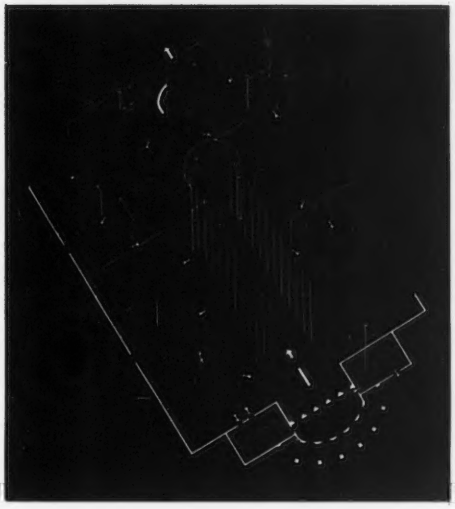
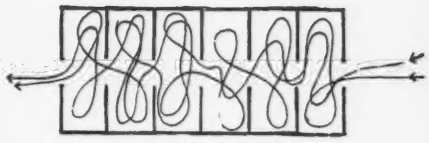


Fig. 6

Fig. 7



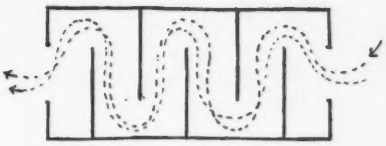


Fig. 8

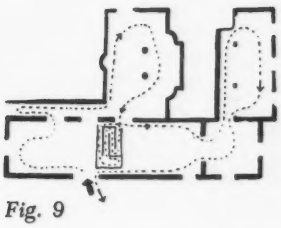


Fig. 9

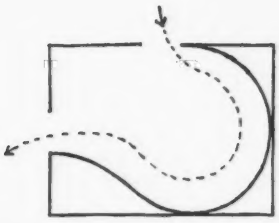


Fig. 10

Fig. 5. Plan of typical exhibition hall in England, 1935 (still typical of today).

Fig. 6. Symmetry in an exhibition in Berlin, 1936.

Fig. 7. Assymmetry in an exhibition in Berlin, 1936.

Fig. 8. Disorder and organization of traffic.

Fig. 9. Plan of circulation, Werkbund Exhibition, Grand Palais, Paris, 1930.

Fig. 10. Curved wall.

Fig. 11

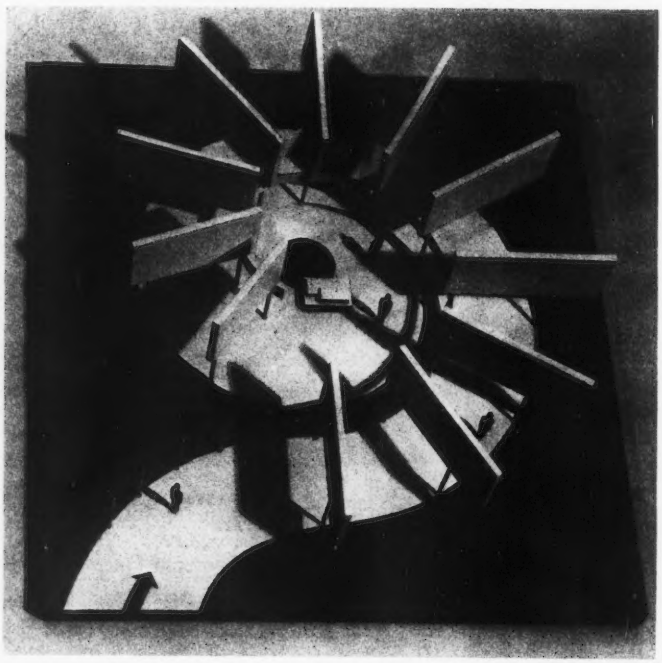


Fig. 12

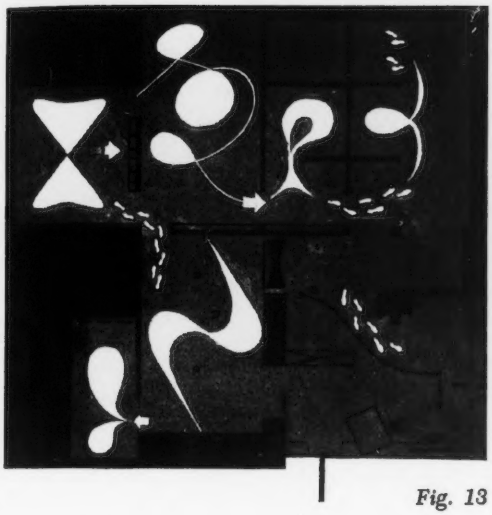


Fig. 13

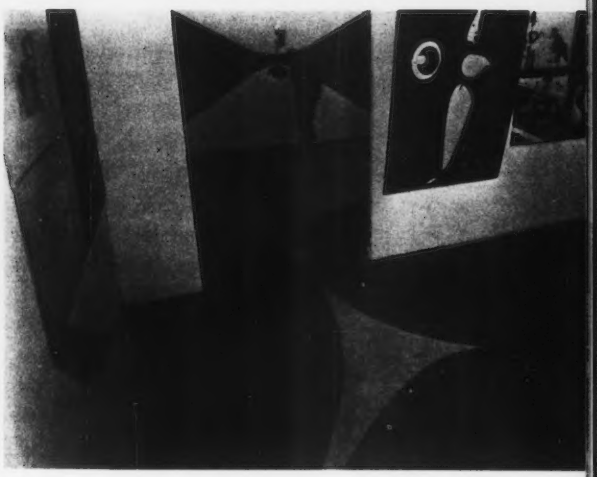


Fig. 14

Fig. 11. Exhibition of the Building Workers' Unions in Berlin, 1931. Bridge and structures: Walter Gropius; exhibits: Herbert Bayer and Moholy-Nagy.

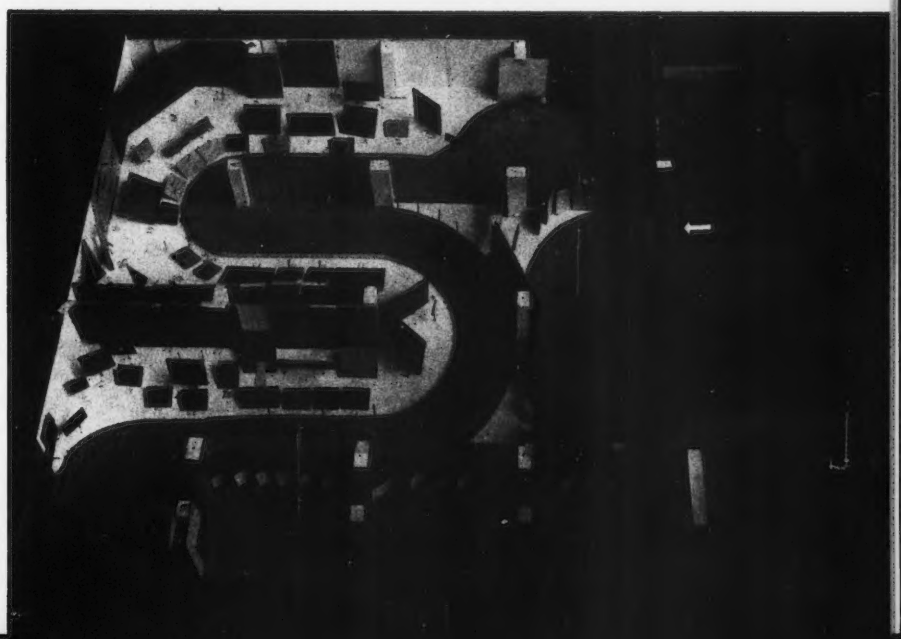
Fig. 12. Model of exhibition "The Community" in Berlin in 1936. Herbert Bayer.

Fig. 13. Floor plan of the exhibition "Bauhaus 1919–1928," at the Museum of Modern Art in New York in 1938. Herbert Bayer.

Fig. 14. Partial view of the exhibition "Bauhaus 1919–1928" in New York in 1938. Herbert Bayer.

Fig. 15. Model of the exhibition Road to Victory, New York, 1942. Herbert Bayer.

Fig. 15



had to be adjusted to the given layout and the sizes of the rooms. Two illustrations show parts of the floor treatment.

A photographic exhibition, "Road to Victory," depicting the life of the American nation during the war, was installed at the Museum of Modern Art in New York in 1942. The complete dependence of the layout on the directional flow of the visitor, so that he could pass through the exhibition and look upon the displays in the desired sequence, is evident from the model. More than half of the linear length of the visitor's walk was over a ramp which enabled him to get long views as well as close views of small and giant photographs. By raising the viewing point it became possible to place many of the exhibits on the floor.

The idea of a planned circulation was carried so far that it became the central motif for an entire building in Le Corbusier's Musée d'Art Moderne. The design motif of an endless spiral is appropriate in its use when, as in this case, it serves to demonstrate a historical development. A similar idea was the basis for the Guggenheim Museum in New York by Frank Lloyd Wright. Here, however, the arrangement of exhibits along a predetermined path is inappropriate, as this museum is not primarily historical. The path itself in this case over a continuous ramp is confining in effect.

The diagrams of two exhibition buildings at the World's Fair in Paris in 1937 induce us to assume that by this time the concept of a planned circulation had been generally accepted as one of the fundamentals of exhibition design.

A more playful design along the same lines is the children's labyrinth at the Triennale in Milan, 1954, a very attractive solution derived directly from the idea of a continuous and leisurely movement while the viewer is looking at the presentations along the varied curved spaces. Curved walls were used again in the United States pavilion at the Brussels World's Fair in 1958. Here, the curved wall does not have the appeal as in the previous example. Furthermore, curved surfaces are not well suited to display the precision of architecture's straight lines, as they cause distortion.

DISPLAY AND EXHIBITS

In the imitative Beaux Arts style of early exhibitions, displays were usually designed as decorative stage sets, oblivious of purpose and character of the displayed objects; as long as they were "beautiful," they apparently were satisfactory. Today it would be considered a misconception if the subject itself were not put forth convincingly, while the auxiliaries necessary to this end would assume no more than the required importance. Any analysis as to purpose and content of a projected exhibit will result in a specific solution. The subject must be brought close to the spectator

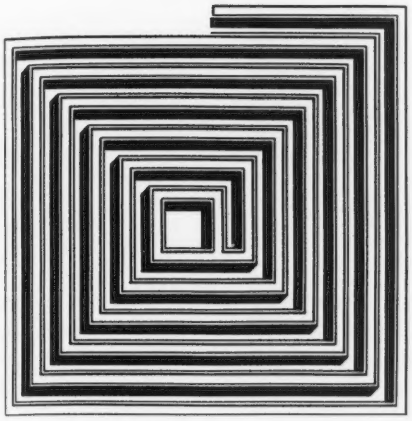


Fig. 16

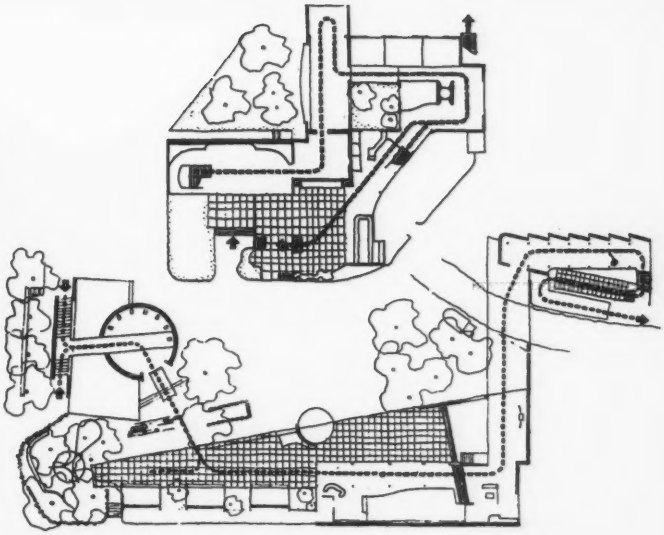


Fig. 17

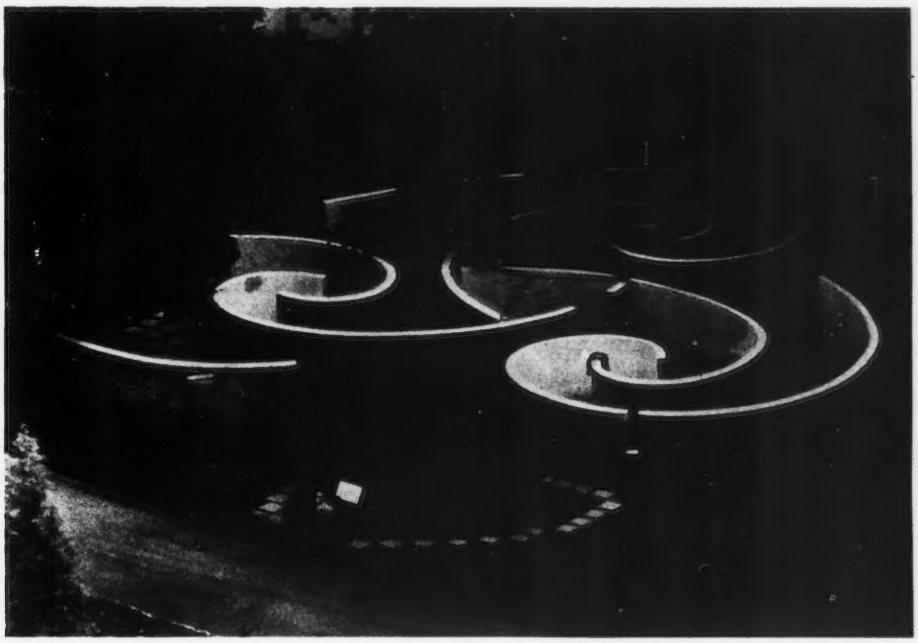


Fig. 18

Fig. 16. Model of the Musée d'Art Moderne. Le Corbusier.

Fig. 17. Plans of two buildings at the World's Fair in Paris in 1937.

Fig. 18. Children's labyrinth at the Triennale in Milan, 1954. Belgiojoso, Peressutti, and Rogers.

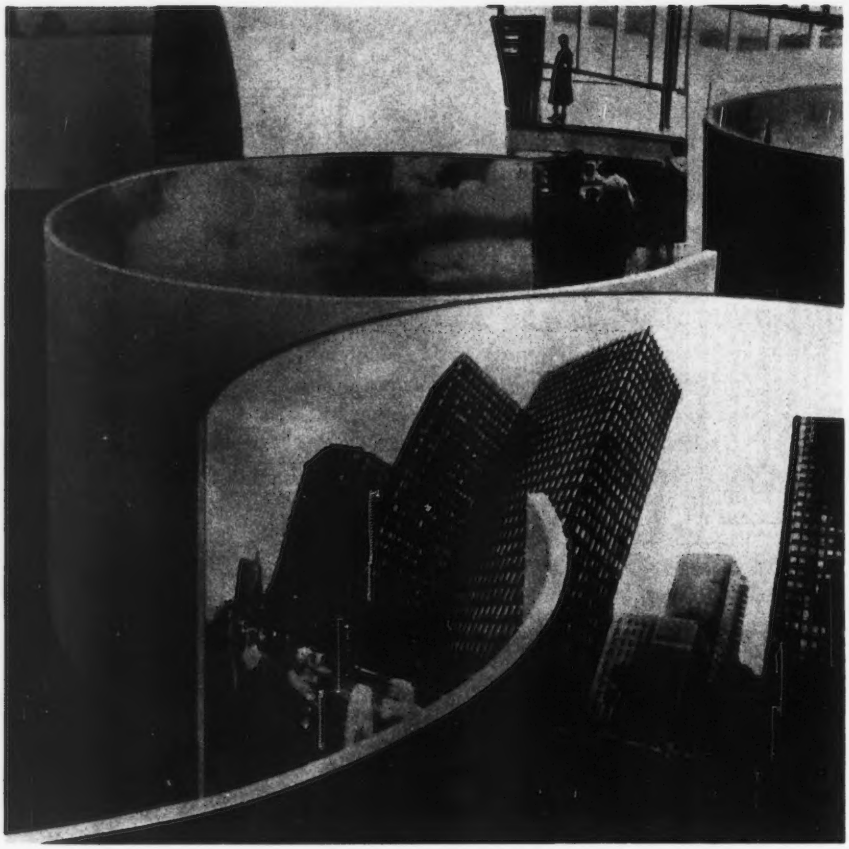


Fig. 19. Exhibit of architecture, United States pavilion, World's Fair, Brussels, 1958.

and leave an impression on him. It must explain, demonstrate, and persuade him, and even lead to a planned reaction. The presentation must serve in support of the subject. The Italian designer Carboni says, ". . . tutto viene subordinato all'idea centrale espressa in sintesi . . ."

We have today for our convenience an elaborate and diverse language with which to operate in the expression and spacial formulation of any exhibition topic. A brief historical review will serve to explain some aspects of its development.

The picture of the Crystal Palace, London, 1851, shows an orderly arrangement of many small displays within the elegant architectural structure. If we take a closer look at some individual displays of the Gewerbe Ausstellung in Berlin, 1896, we can hardly identify the nature of the exhibits. They are, in themselves, overpowering to the degree of subordinating the exhibited material. The purpose of the pompous attempt to lift the exhibited products onto a higher plane of beauty seems to be to add an air of dignity by means of autocratic, architectural creations.

The tower of 1871 built with matches and matchboxes also suggests that the exhibit was designed for its own design's sake and that the product itself, used as building stones, was reduced to a secondary role. This sort of superficial beautification and historical eclecticism ruled exhibition design of the nineteenth century, and it was not until the 1920's that the tide turned towards analytical methods.

The display productions of recent years would be different were it not for experiments and inventions of some of the art "isms." In the exhibition of the Russian constructivists in Moscow in 1921, we notice that a radical elimination of the unessential took place. Space and sculpture were created with elements of construction, largely linear members, in the pursuit of lightness and weightlessness with a minimum use of matter. A revolutionary turning point came when El Lissitzky applied new constructivist ideas to a concrete project of communication at the "Pressa" Exhibition in Cologne in 1928. The innovation is in the use of a dynamic space design instead of unyielding symmetry, in the unconventional use of various materials (introduction of new materials such as cellophane for curved transparency), and in the application of a new scale, as in the use of giant photographs. At the "Pressa" and subsequently at the Trade Fair in Leipzig El Lissitzky first used montage techniques with photo-enlargements.

Exhibition techniques and new concepts in graphic design in conjunction with a new architecture were actively pioneered in Germany from the mid 1920's on. Italy and countries such as Switzerland and Sweden have further developed this new medium and have had occasion to practice it extensively.

VISUAL COMMUNICATION

In the sign of the Sicilian blacksmith painted on the wall of his workshop, what the blacksmith is doing and what product he is manufacturing become precisely clear without the use of one word. This is communication by picture language at its simplest. It has been stated above that communication in museums and exhibitions must be governed by directness, simplicity, brevity, and by ways allowing for precision and ease of perception. A great variety of techniques is at our disposal to this end, as the following discussion of a few successful examples will point out.

The advertising folder for a ski resort illustrates the freedom in the use and in the combination of various media. Not only are photographs and photo-montages used here, but also a map projection and other illustrations. But the traditional static point of view towards a perspective space illusion has been abandoned in favor of altogether different viewpoints. The result is a dynamic design which captures the reader's attention and retains his interest.

The designer is often faced with the task of making non-visual ideas visible. In a folder for a biology exhibition, "Das Wunder des Lebens," one of the problems was to explain the physical power of the human heart. The illustration shows that the heart beat, transformed into electric power, can generate sufficient strength to operate the elevator of the Funkturm, a landmark of Berlin.

One of the important areas of work for the graphic designer today is in the service of science. There are innumerable problems which require the gifted visual communicator. This is a field of much greater import than advertising to which most graphic designers turn because of the existing demand and because of monetary advantages. Good graphics in support of science and education will in the future receive increasing attention. The abbreviated visual explanation of how television works only touches on the multitude of scientific subjects that need the artist in the task of the dissemination of knowledge.

A chart of the organization of a large chemical concern is expressed with suggestive, decorative forms and colors in an attempt to make a chart more attractive than is usually seen.

The function of the human brain by way of electromagnetic streams was explained in *Life* magazine. The event of an approaching car and a pedestrian's reaction to avoid being run over were pictorially reconstructed. The series of immediate electric impulses in the brain leading to the automatic reaction of the pedestrian are shown in consecutive stages.

The diagrammatic drawing of traffic control by radio beams and the stacking of airplanes over a crowded airfield demonstrates the necessity for this kind of visualization in the service of our complex technology.

Statistics often lack imagination, but they too can be made graphic and arresting, as was illustrated by a photograph that appeared in a British magazine showing a densely massed crowd of 7250 people, equivalent to the number killed in Great Britain's road accidents in 1934.

The amount of food that one man consumes in an average lifetime of fifty-five years is presented in exact relation to the man's own size, another visual interpretation of statistical content.

These examples of effective visual communication have by no means exhausted the possibilities, but call attention to an important subject.

FIELD OF VISION

Traditionally the direction of viewing in museums and exhibitions is horizontal. During the design of the exhibition of the German Werkbund in Paris in 1929, the author explored possibilities of extending the field of vision in order to utilize other than vertical areas and activate them with new interest. The normal field of vision becomes larger by turns of

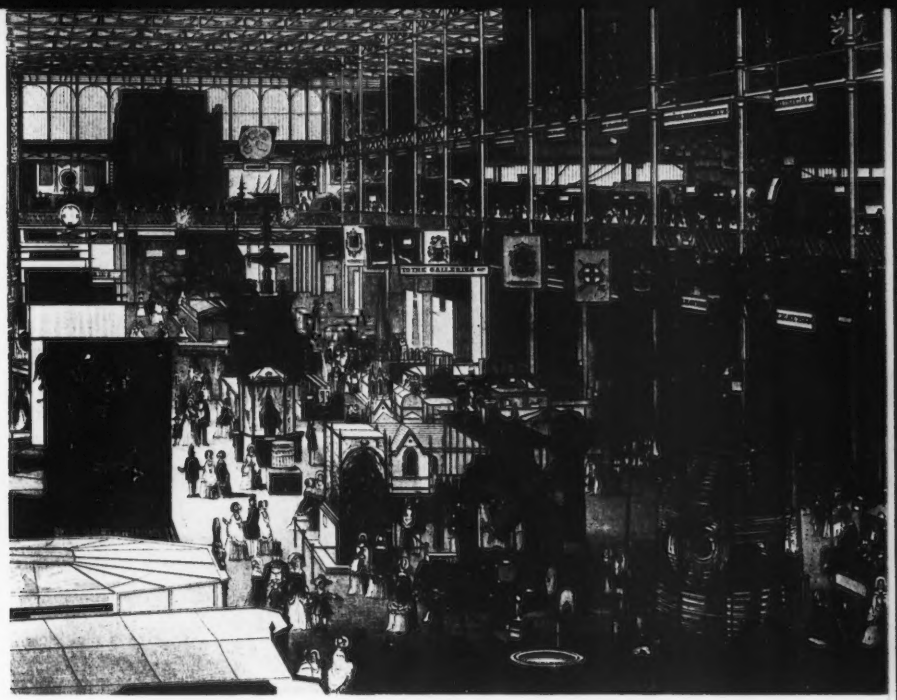


Fig. 20

Fig. 20. Exhibits in the Crystal Palace, London, 1851.

Fig. 21. Displays at the Gewerbe Ausstellung, Berlin, 1896.

Fig. 22. Display of match products, 1871.

Fig. 21

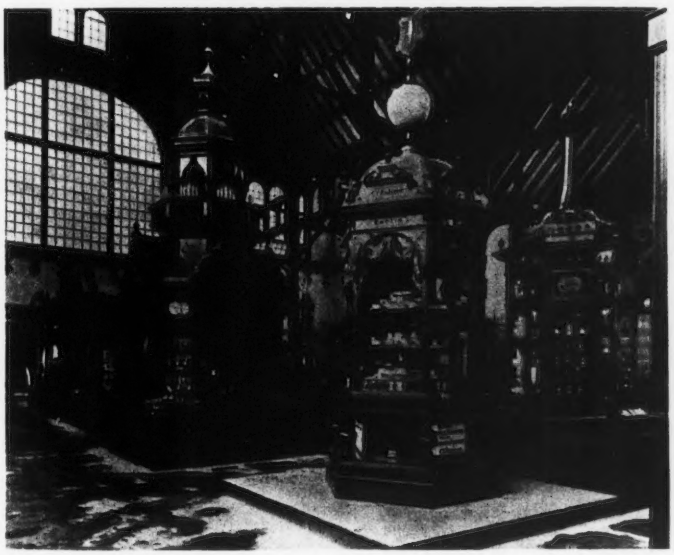


Fig. 22

the head and body, whereby the direction of viewing and the relative position of exhibits gain new possibilities.

The first application of the principle of extended vision is shown in the photograph from the exhibition "Deutscher Werkbund" in Paris in 1930. The freedom gained from this theory is also demonstrated in the unorthodox display of chairs on the wall. That the field of vision can be further extended by raising the visitor up to a higher viewing and walking level becomes evident in a diagram of later origin.

The idea of the visitor's improved vision has also led to the concept of the "outside-in" world globe of the exhibition "Airways to Peace" at the Museum of Modern Art in New York in 1943. The larger a globe is, the less is the surface area that can be seen from one point. The outside surface of the globe was for this reason projected onto the inside of a hollow globe into which the visitor could walk. Here he could more easily get a composite picture of the world map and the true relationship of land and sea areas. Flat maps are always distorted, whatever kind of projection is used. To show the real facts of given geographic situations, concave semiglobes were devised in the same exhibition to produce a true vision. It is known that many strategic errors were made in wars and that grave misconceptions were the result of consulting distorted maps instead of globes.

MEANS OF DISPLAY

It has been expressed above that in most exhibitions and displays of the late nineteenth and the beginning of the twentieth century, the subject of the exhibition itself was often overpowered and suppressed by the design of the display.

Every subject is conditioned by its individual nature, by content, size, or special limitations. Out of these conditions, concepts of display will develop in a different manner in every case. Originality often follows in the course of an analytical working process. This logical approach represents no monopoly of the exhibition designer but is the basis of all good design. It may be said, however, that this is, unfortunately, not sufficiently understood. Each subject calls for and suggests evocative expressions which are exclusively derived from this particular subject. The physical means by which the content of exhibits is brought to the attention of the visitor should not in themselves be autocratic or domineering. They are employed to serve the intent of the exhibition in the best possible manner and are, therefore, not the primary elements.

In an exhibition of giant photographs depicting the American nation at work, the photographs were placed without frames and without visible supports. It was possible here to eliminate all elements, structural and otherwise, that might detract from or interfere with the images themselves. The ultimate solution of this train of thought would be displays

continued on page 276

Fig. 23. Constructivist art exhibition in Moscow in 1921.

Fig. 24. Russian exhibit, "Pressa" book show, Cologne, 1928. El Lissitzky.

Fig. 25

Fig. 26

Fig. 25. Shop sign for a blacksmith, Sicily, 1923.

Fig. 26. The power of the human heart, from a booklet "Das Wunder des Lebens," 1934. Herbert Bayer.

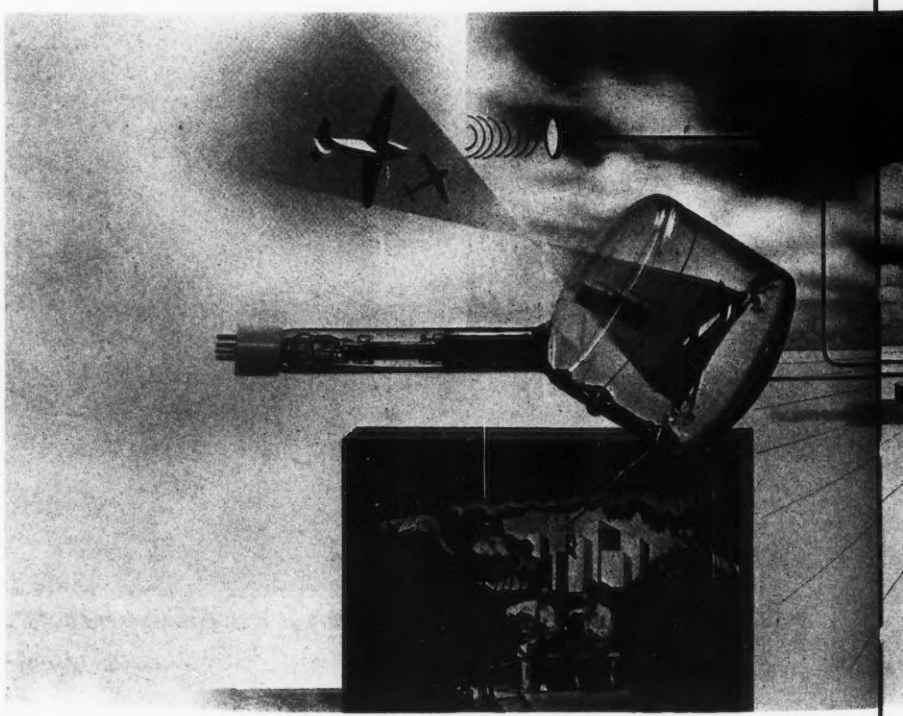


Fig. 27

Fig. 27. Advertising folder for ski resort, Mont Tremblant, Canada, 1939. Herbert Bayer.

Fig. 28. Television, from a booklet "Electronics," General Electric Company, 1941. Herbert Bayer.

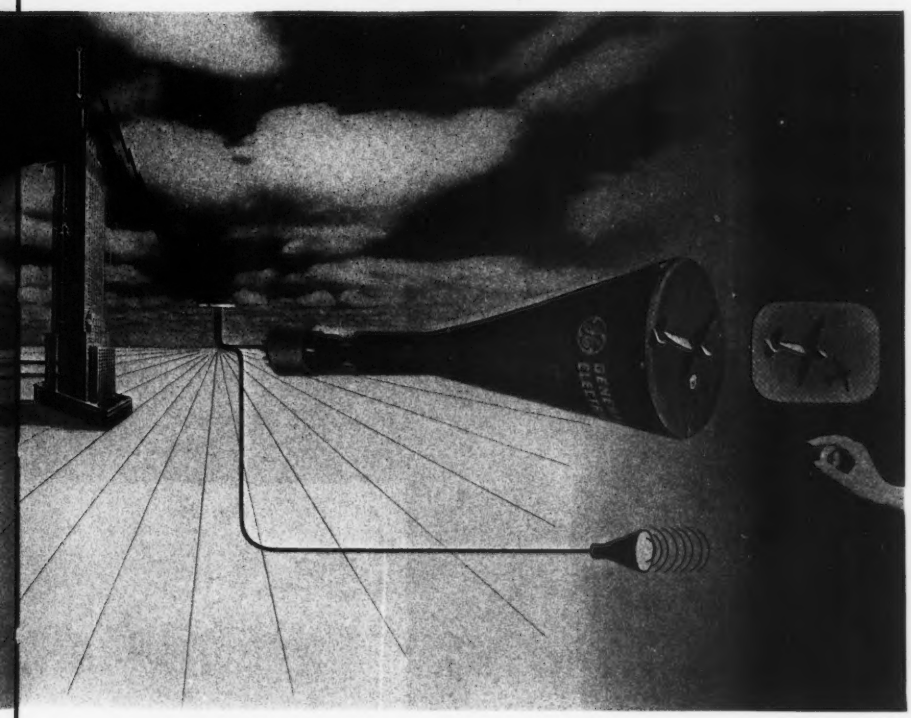


Fig. 28

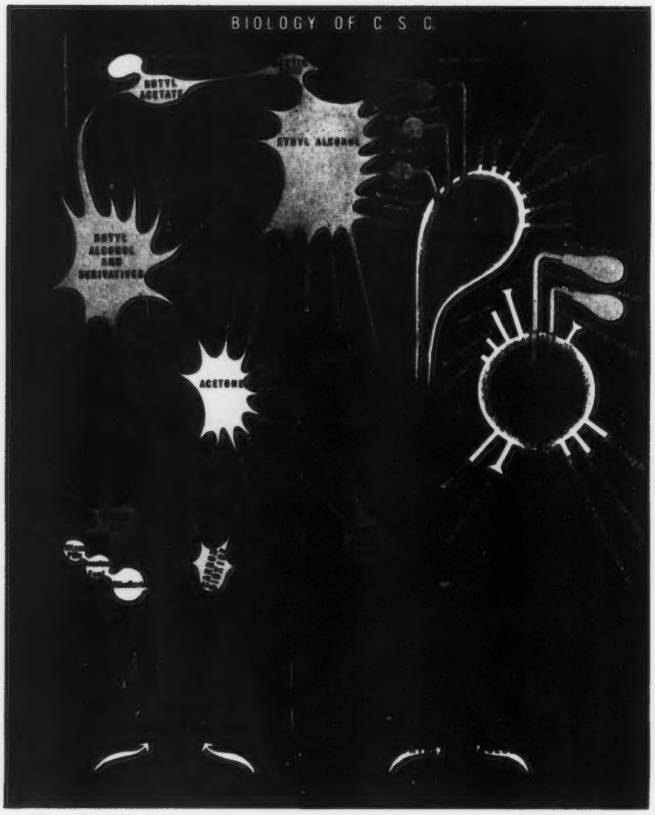


Fig. 29

Fig. 30

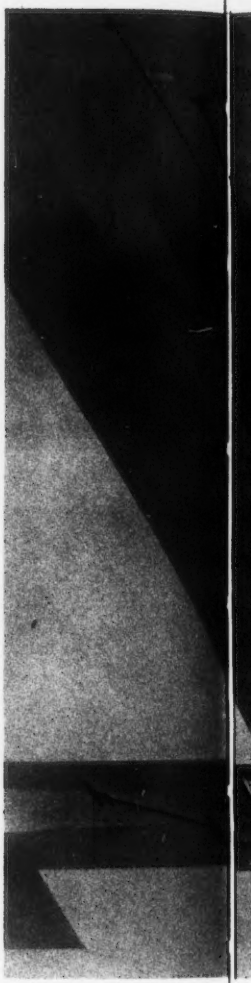


Fig. 31

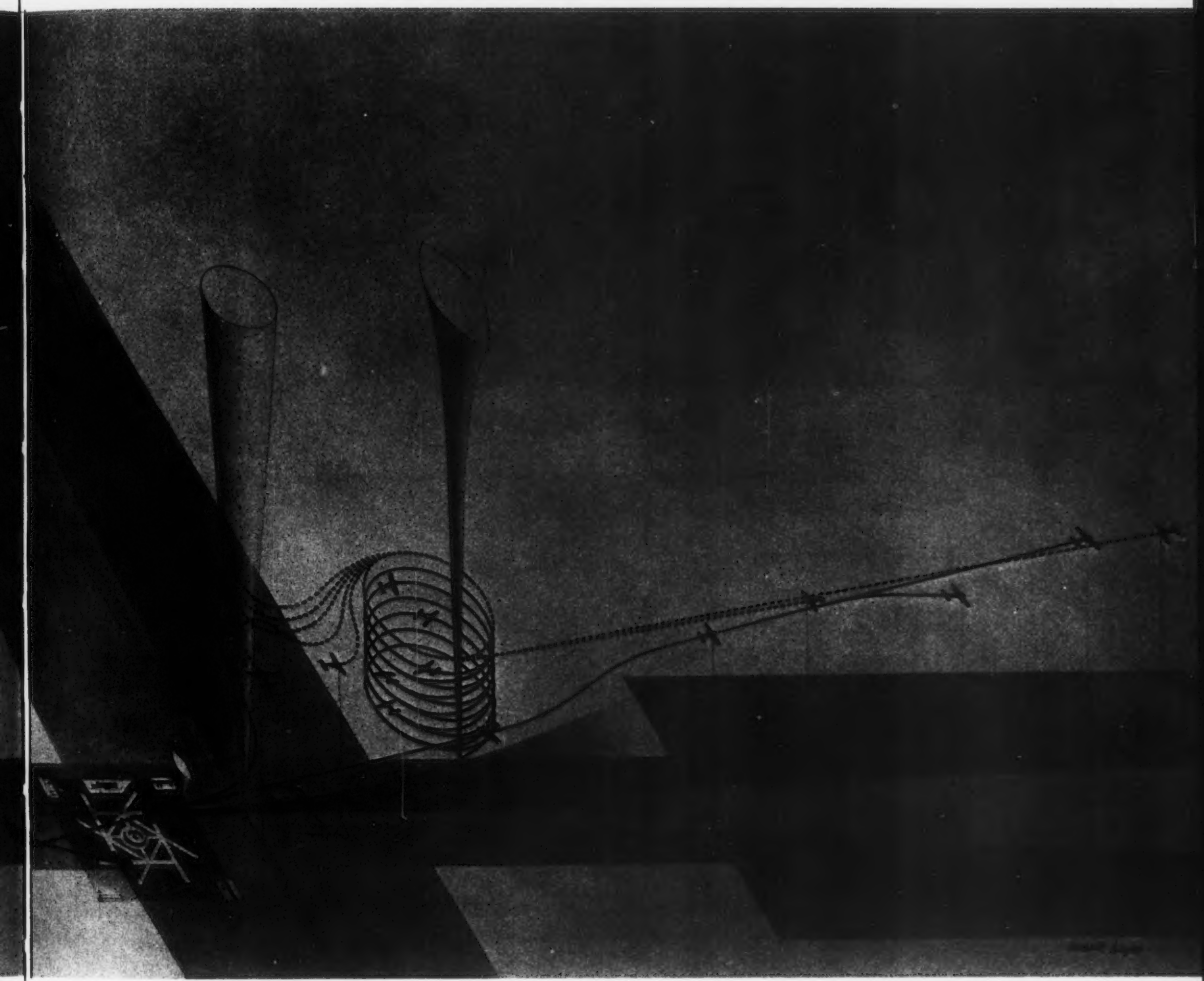


Fig. 29. Chart prepared for Fortune *magazine, October, 1944. Herbert Bayer.*

Fig. 30. The human brain, from Life *magazine, 1939. Herbert Bayer.*

Fig. 31. Airport traffic control, 1942. Herbert Bayer.

Fig. 32. Statistics of human food consumption, from "Das Wunder des Lebens," 1934. Herbert Bayer.

created without any material effort or visible support, placed in midair by methods of the future.

SEQUENCE AND WALKING DIRECTION

An exhibition can be compared with a book insofar as the pages of a book are moved to pass by the reader's eye, while in an exhibition the visitor moves in the process of viewing the displays. Reading a book, however, is a more restful occupation as compared to the physical efforts that are necessary for perceiving communications simultaneously with the act of walking. Attempts to ease perception must, therefore, be made in exhibition design. The reading method of Western man is from left to right. The walking direction in exhibitions must, logically, also be from left to right. Even a succession of displays in depth implies a movement from left to right. Only if presentations are executed with pictures or by picture language can a succession of images or a story in sequence be told while a viewer is moving from the right to the left.

LIGHTING

Lighting of exhibitions is often complex, but it is of great importance. The accompanying figures show some of the principles of lighting in museums, where the problem is largely that of an over-all illumination. However, direct spotlights and individual brighter sources of light must

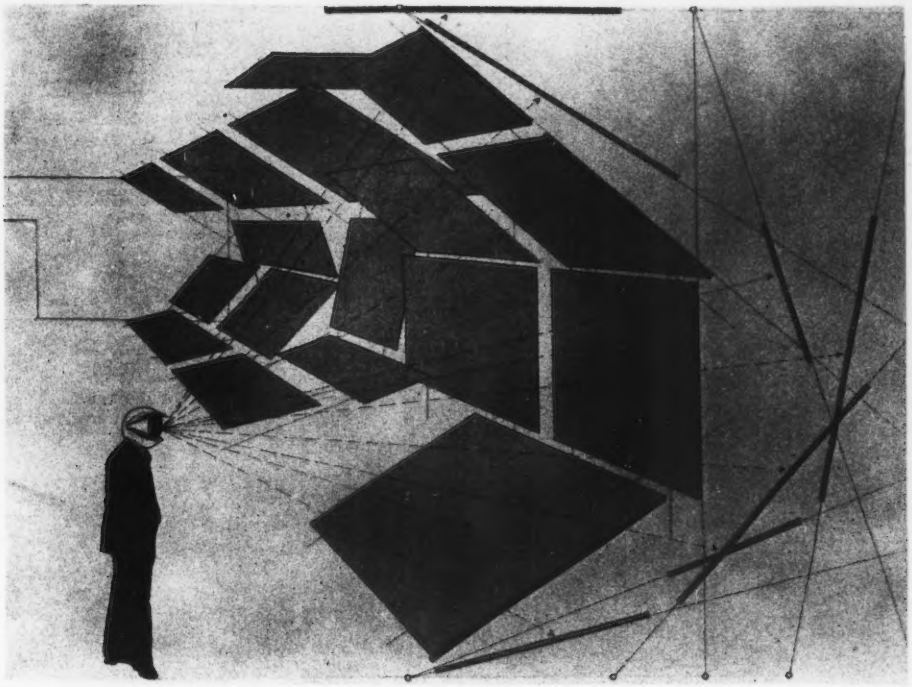


Fig. 33

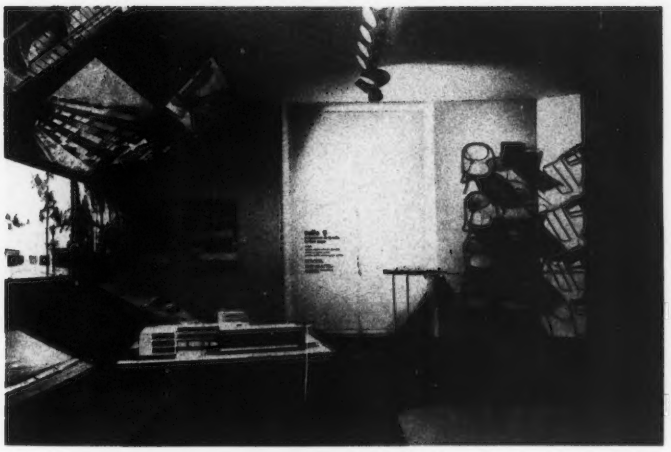


Fig. 34

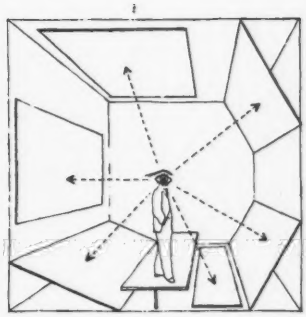


Fig. 35

Fig. 33. Extended vision, from the catalogue of the Werkbund Exhibition, Paris, 1929. Herbert Bayer.

Fig. 34. Display of architecture and standard furniture, Werkbund Exhibition, Paris, 1930. Herbert Bayer.

Fig. 35. Diagram of extended vision, 1936. Herbert Bayer.

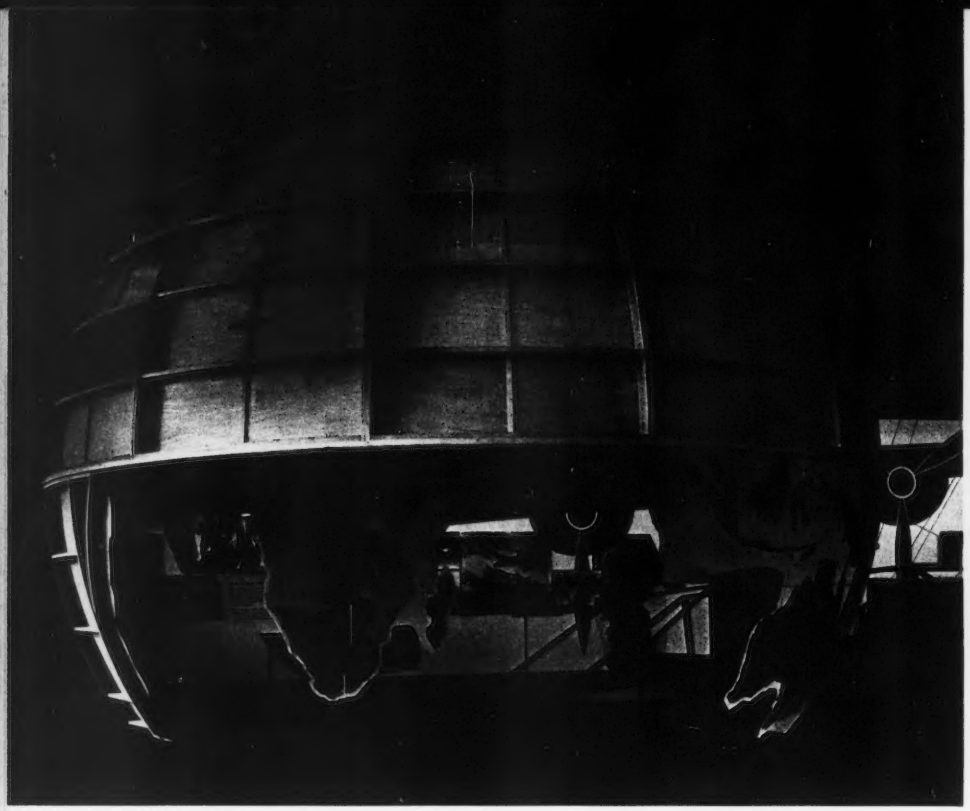


Fig. 36

be used to break the monotony of an even illumination in a lower key, to emphasize individual exhibits. Above all, changes in light intensity are desirable to keep the visitor's interests alive. Museums and exhibitions have largely become independent from daylight, for the simple reason

Fig. 36. "Outside-in" world globe, in exhibition "Airways to Peace," New York, 1943. Herbert Bayer.

Fig. 37. Interior view of "outside-in" globe, also showing concave semi-globes.

Fig. 38. "Road to Victory" exhibition, 1942. Herbert Bayer.

Fig. 39. Reading direction.

Fig. 40. Walking direction.

Fig. 41. Succession in depth.

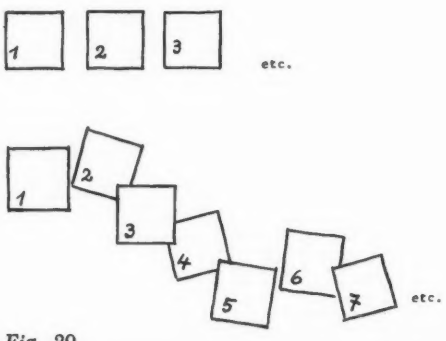


Fig. 39

Fig. 37

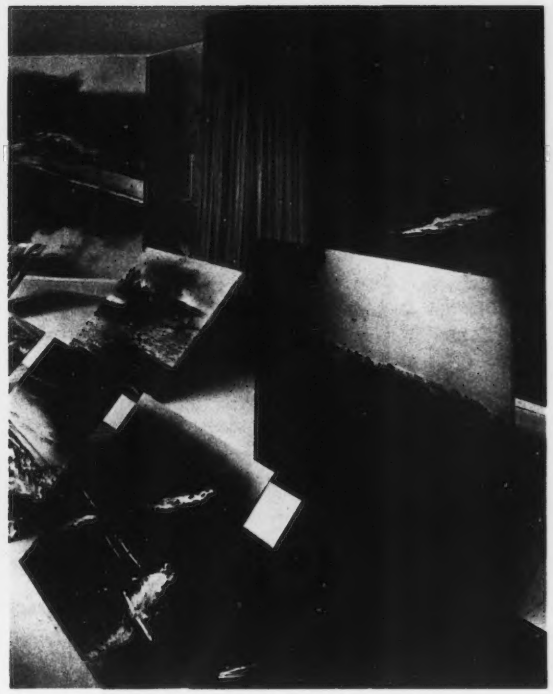
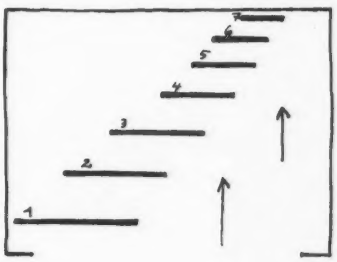


Fig. 38

that artificial light can be better controlled towards the intended purpose.

A sectional drawing of Le Corbusier's Museum of Modern Art in Tokyo shows the utilization of diffused daylight plus the use of indirect and direct lighting systems.



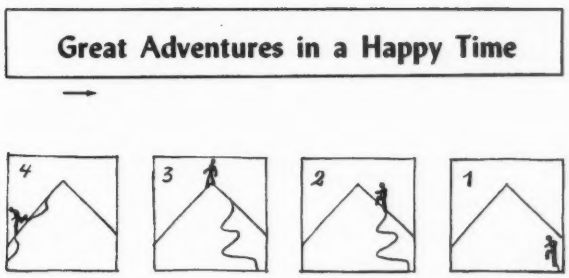


Fig. 40

Fig. 41

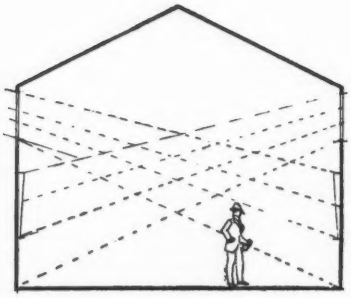


Fig. 42

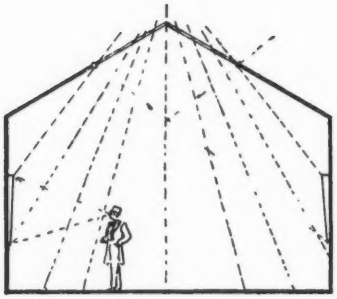


Fig. 43

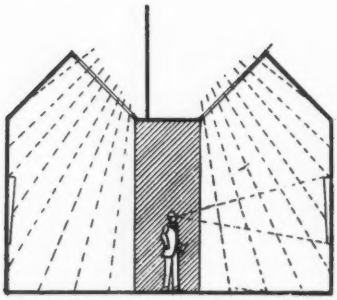


Fig. 44

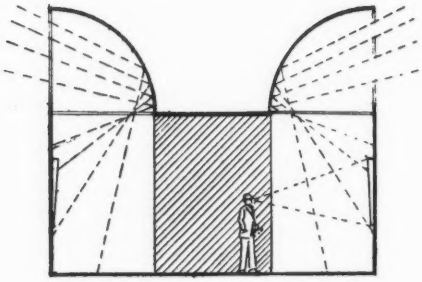


Fig. 45

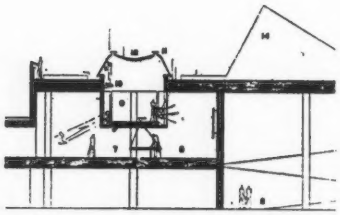


Fig. 46

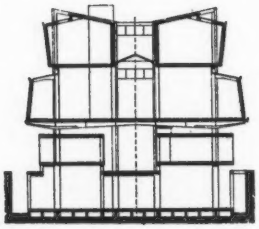


Fig. 47

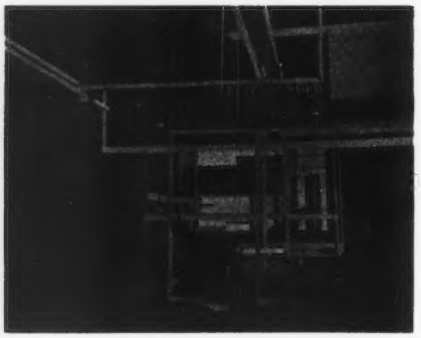


Fig. 48

Figs. 42–45. Methods of museum lighting, from the catalogue of the Exposition Internationale de 1937 in Paris.

Fig. 46. Section, Museum of Modern Art, Tokyo, 1957. Le Corbusier.

Fig. 47. Section, Museum of Modern Art, Turin. Bassi and Boschetti.

Fig. 48. Austrian theater exhibition at the Exposition Internationale des Arts Decoratifs, Paris, 1925. Frederick Kiesler.

The section of the Museum of Modern Art in Turin suggests that the architectural concept of this building has been guided by the efficient utilization of diffused daylight.

EXHIBITION STRUCTURES

The ever-increasing dissemination of information and exchange of thought has produced a new traveling form of exhibition which is no longer localized in permanent buildings but consists of light-weight, standardized, flexible, movable, structural units which can be erected independent from walls or any floor space.

These structures were initially influenced by the art theories of De Stijl as well as by works of constructivism. The former fathered innumerable versions of demountable frameworks for traveling shows initiated by Frederick Kiesler's Austrian theater exhibition at the Exposition Internationale des Arts Decoratifs in Paris in 1925. This is, to the author's knowledge, the first known space definition by a structural skeleton and is an extension of the art theories of De Stijl into the three dimensional—an exposed framework supporting exhibits and text on various colored panels.

A prefabricated system of tubular members was used in 1934 in Milan as a large framework to support exhibits. In the exhibition "Studies of Proportion" in Milan, 1951, a more elegant framework was used in the author's sense of "extended vision" and thereby added new dimensions to the definition of open spaces.

Since then many systems of demountable frameworks have been devised for the purpose of traveling exhibitions. Of more recent origin are two connector systems, one for round tubes and one for square tubular members. In general, however, it must be stated that most of these systems are as yet too complicated to erect and to take apart. Even industrial systems such as the American "Unistrut" product require too much labor for larger structures to be economical.

Probably one of the simplest systems is that of round posts onto which panels are hooked. The exhibit is stabilized through the pleated arrangement.

One of the first wooden structures for demountable traveling exhibitions was that of the Container Corporation of America in 1945.

In the design of the United States Air Force Museum, an attempt was made to incorporate the previously made observations. Most museums are traditionally monumental structures and rigid in their layout. I believe, however, that the museum exists to serve the visitor, not only to impress him. It must, therefore, be on a human scale. The Air Force Museum was limited to a size which would not overtax the visitor's strength nor tire his capacity of perception.

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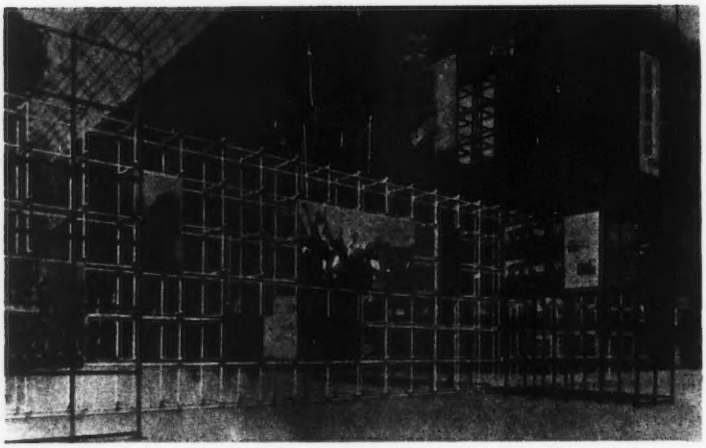


Fig. 49

Fig. 50

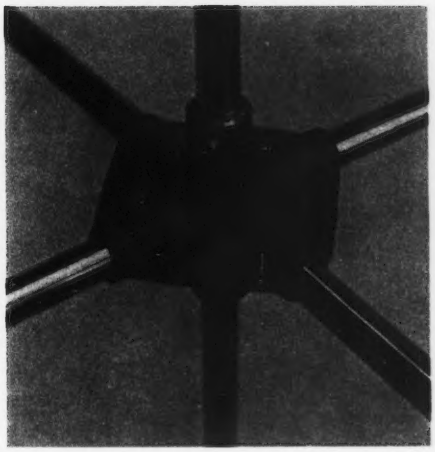


Fig. 51

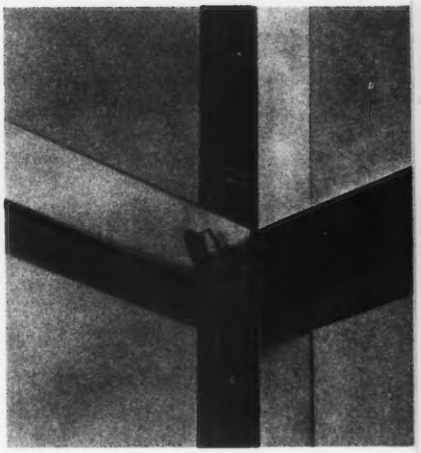


Fig. 52

Fig. 49. Tubular structure, Milan, 1934. E. Persico and M. Nizzoli.

Fig. 50. Exhibition "Studies of Proportion," Triennale, Milan, 1951. F. G. Ruscone.

Fig. 51. Connecting system for tubular structure, Zürich, 1959. Fritz Keller.

Fig. 52. Tubular connecting system, Zürich, 1959. Fritz Keller.

Fig. 53. Traveling exhibition "United Nations," 1943, for the Coordinator of Inter-American Affairs. Herbert Bayer.

Fig. 53

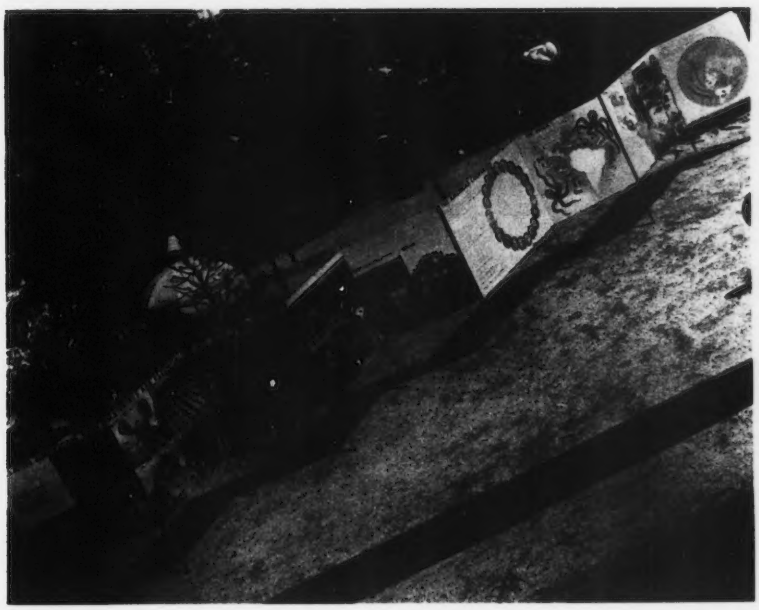


Fig. 54

A major attraction in this museum will be the many interesting historical aircraft that have been collected here. Displaying very large objects such as these next to very small ones presented a problem. To prevent exhibits from being touched or mishandled, they must be placed beyond reach or protected in showcases. To comply with these facts a ramp has been designed for the purpose of leading the visitor clearly in chronological order through the museum. The ramp will raise him to a viewing point that will be adjusted to large and small objects. It will extend his vision by including the floor as exhibit area and by permitting him to view objects not only horizontally but in all directions. The ramp also will keep him at a distance from valuable objects, and restricting the walking area mostly to the ramp will facilitate maintenance and cleaning. Floor areas that are not to be walked on will be painted white.

The focus and interest will be directed to the displays themselves. Structures that support exhibits and objects will be as inconspicuous as possible

and will let the subjects speak for themselves.

A grid ceiling of a large module will diffuse and reasonably well conceal the over-all illumination suspended above. This will be supplemented by spotlights and other light sources for special exhibits.

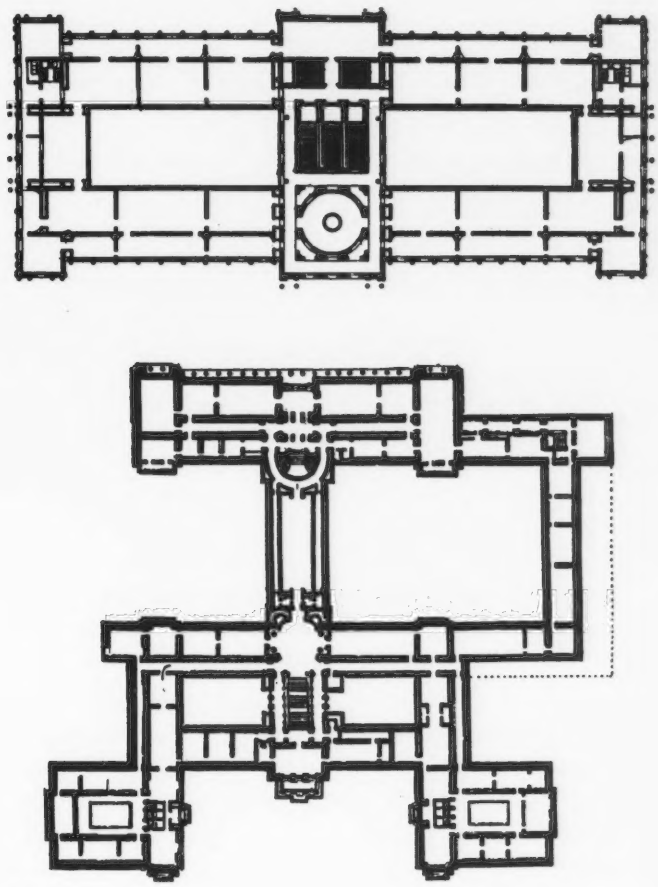


Fig. 55

Fig. 54. Traveling exhibition "Art in Industry," Container Corporation of America, 1945. Herbert Bayer.

Fig. 55. Plans of the Kunsthistorisches Museum in Vienna, 1872–1891, and of the Museum of Fine Arts in Boston, 1907–1928.

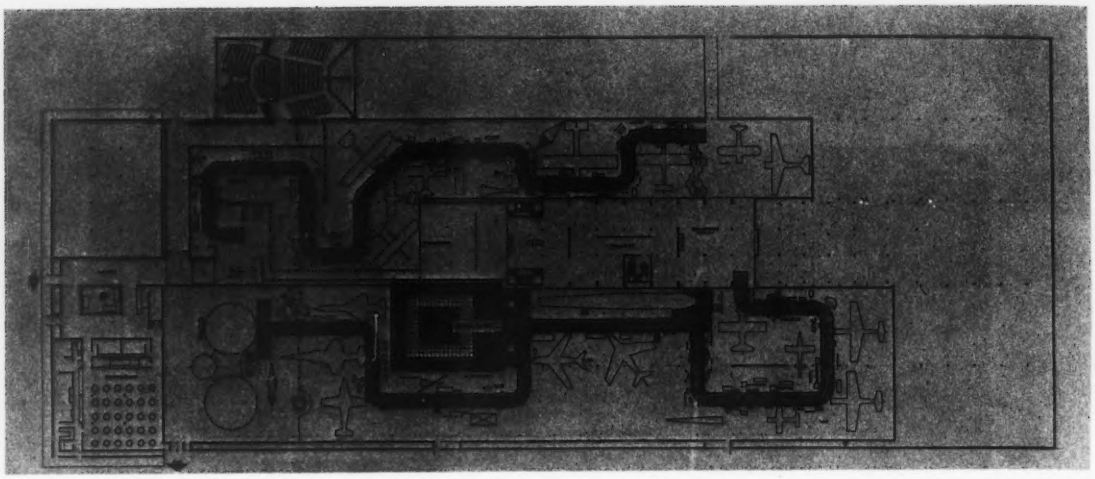


Fig. 56

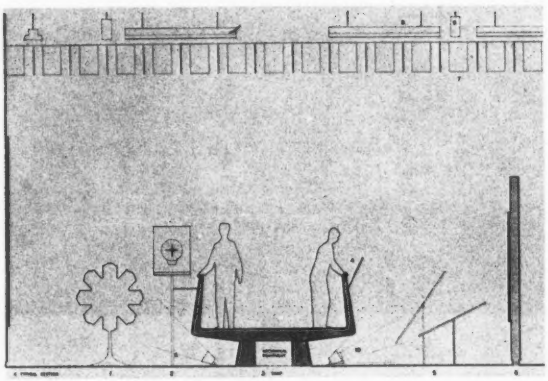
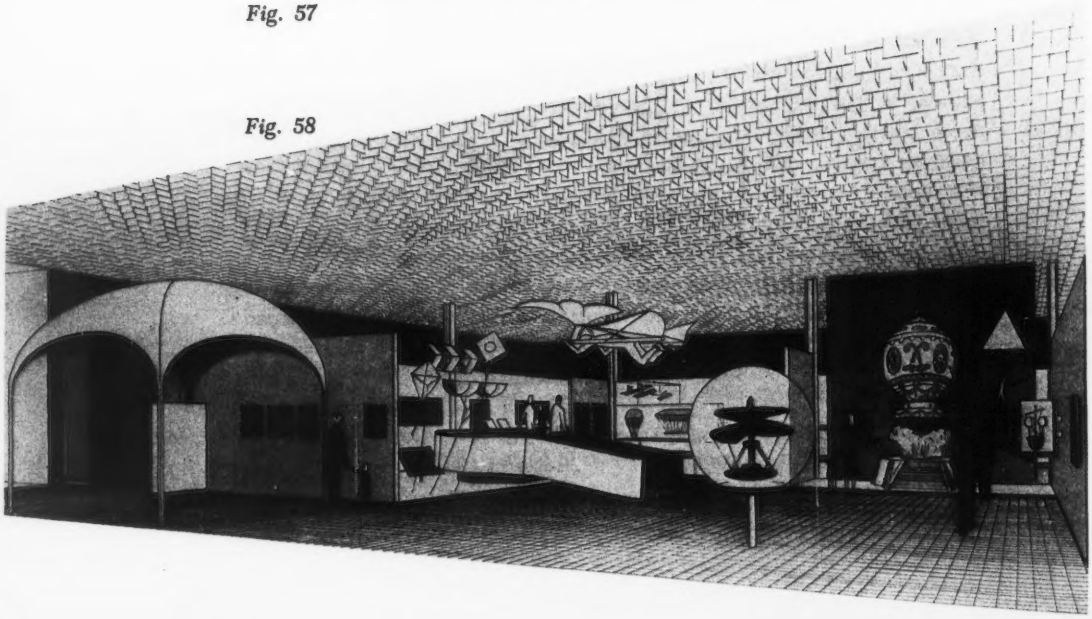


Fig. 57

Fig. 58



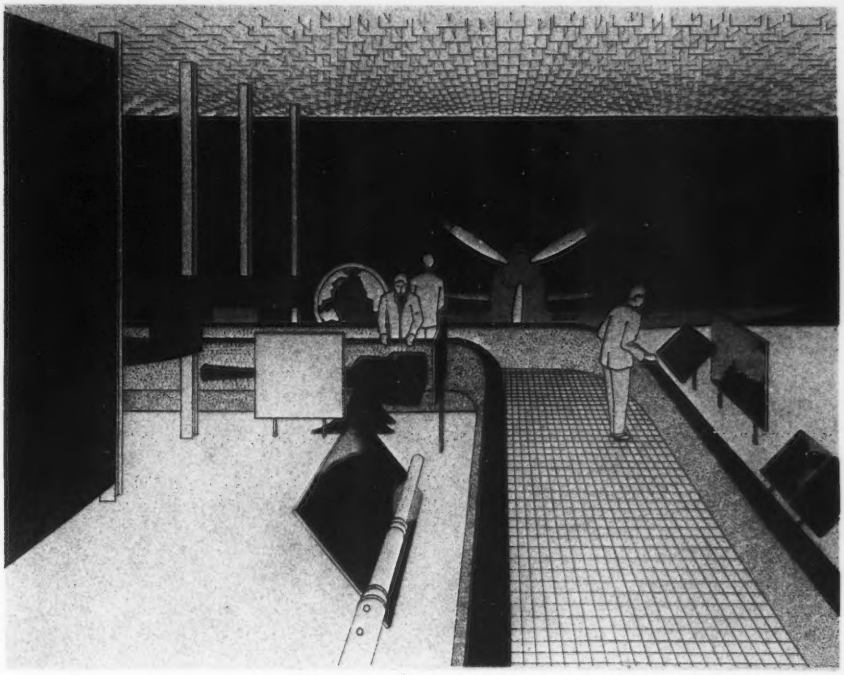


Fig. 59

Fig. 56. Plan of United States Air Force Museum, Wright-Patterson Air Force Base, Ohio, 1960. Herbert Bayer.

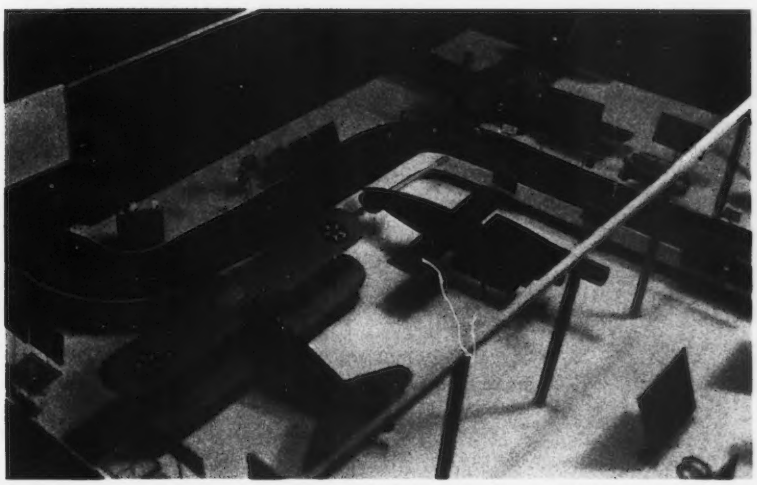
Fig. 57. Typical section of the United States Air Force Museum, 1960.

Fig. 58. Partial view of Theme I, "Fantasy of Flight," Air Force Museum, 1960.

Fig. 59. Typical view of ramp and exhibits, Air Force Museum, 1960.

Fig. 60. Photograph of model Air Force Museum, 1960.

Fig. 60



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